WHY ARE CONVERTIBLE BOND ANNOUNCEMENTS ASSOCIATED WITH INCREASINGLY NEGATIVE ABNORMAL STOCK RETURNS? AN ARBITRAGE-BASED EXPLANATION

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Abstract

While convertible offerings announced between 1984 and 1999 induce average abnormal stock returns of −1.69%, convertible announcement effects over the period 2000 to 2008 are more than twice as negative (−4.59%). We hypothesize that this evolution is attributable to a shift in the convertible bond investor base from long-only investors towards convertible arbitrage funds. These funds buy convertibles and short the underlying stocks, causing downward price pressure. Consistent with this hypothesis, we find that the differences in announcement returns between the Traditional Investor period (1984-1999) and the Arbitrage period (2000-September 2008) disappear when controlling for arbitrage-induced short selling. Post-issuance stock returns are also in line with the arbitrage explanation. Average announcement effects of convertibles issued during the recent financial crisis are even more negative (−9.12%). This result can be attributed to the severe underpricing of crisis-period convertible offerings, which outweighs the impact of the diminished influence of convertible arbitrage funds.

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1. Introduction

Convertible bonds are hybrid securities that combine features of straight debt and equity. They resemble straight debt by paying a fixed coupon rate, and they resemble common equity by offering the possibility of conversion into stock as an alternative for receiving the nominal value in cash at the redemption date. Convertibles are a popular source of financing. Over the past 30 years, convertible debt issuance comprised approximately ten percent of total securities issuance by U.S. corporations.[1]

Existing event studies on the announcement effects associated with convertible debt offerings generally focus on convertibles issued during the 1970s and 1980s. A common finding of these studies is that convertibles induce negative abnormal stock returns that are intermediate in size between the announcement effects associated with seasoned equity and straight debt offerings (Dann and Mikkelson, 1984; Mikkelson and Partch, 1986; Lewis, Rogalski, and Seward, 1999). This pattern is consistent with the signaling model of Myers and Majluf (1984), which predicts that relatively more equity-like security offerings are more likely to be perceived as a signal of firm overvaluation.

This paper is inspired by the observation that convertible bond announcement effects have sharply declined over the past decade, whereas there is no corresponding decline in equity or straight debt announcement returns. While convertible offerings announced between 1984 and 1999 induce average abnormal stock returns of −1.69%, convertibles announced in the period 2000 to 2008 are associated with average abnormal stock price declines that are more than twice as large (−4.59%).

[1] That is ten percent of the total amount of convertible debt, common equity, and straight debt issued by U.S. firms (excluding financials and utilities). Source: Securities Data Company New Issues database.

We hypothesize that the sharp decline in observed convertible bond announcement returns is attributable to a substantial change in the buy-side of the convertible bond market. Convertibles traditionally appealed to long-only investors looking for diversification benefits and indirect participation in equities (Lummer and Riepe, 1993). However, Choi, Getmansky, and Tookes (2009) show a dramatic increase in the importance of convertible arbitrage funds since the end of the 1990s. To exploit underpriced convertible issues, convertible bond arbitrageurs buy the convertibles and short the underlying common stock. If demand curves for stock are downward-sloping, the supply increase associated with this arbitrage-related short selling should result in a negative stock price effect. Of course, short-selling activities take place when convertible bond arbitrageurs are actually able to buy the offerings, i.e., on convertible bond issue dates rather than on announcement dates. However, for almost all recent convertible bond offerings issuance occurs either on the announcement date or one trading date after that. The very rapid issuance of recent convertibles can be explained by the fact that most of these issues are structured as Rule 144A offerings, which allows for a very fast (often overnight) placement (Huang and Ramirez, 2010). Therefore, our key prediction is that the observed highly negative "announcement" effect of recent convertible bond issues may partly reflect temporary price pressure associated with the activities of convertible bond arbitrageurs.

To test this prediction, we collect a sample of 1,436 convertible bonds issued by U.S. corporations from the Securities Data Company's New Issues database (henceforth SDC). In line with previous studies (Choi et al., 2009, De Jong, Dutordoir, and Verwijmeren, 2010), we construct a measure for the amount of hedging-induced short selling associated

with each convertible bond offering by regressing changes in monthly short interest around convertible bond issues on a number of potential firm-specific, issue-specific and time-varying determinants of arbitrageurs' interest in a given offering. The predicted value of this regression reflects the portion of the change in monthly short interest that can be attributed to short selling by convertible bond arbitrageurs (as opposed to short selling by fundamental traders).

In line with our hypothesis, we find that the difference in announcement-period returns between convertibles issued in the period 1984 to 1999 (labeled "Traditional Investor period") and convertibles issued in the period 2000 to September 2008 (labeled "Arbitrage period") is no longer significant after controlling for our constructed measure for arbitrage-induced short selling. Our findings are robust to alternative specifications of arbitrage-induced short selling, and remain intact when controlling for issuer-specific, security-specific, and macroeconomic determinants of convertible bond announcement effects.

The recent credit crisis placed serious constraints on the ability of convertible bond arbitrageurs to execute their hedging strategy. As a result, the convertible bond buyer base underwent a second important shift, from hedge funds back to long-only investors. In an article in the Financial Times of May 11, 2009, Masters (2009) writes: "*Now hedge funds play a much smaller role in the investor base, representing less than half of the buyers of new issues* (of convertible bonds) *in many cases.*" In line with this comment, Hutchinson and Gallagher (2010) show a strong decline of the number of unique convertible bond arbitrage funds in the TASS database after August 2008. From an arbitrage viewpoint, we therefore expect to observe less negative abnormal returns for

convertibles issued during the financial crisis. However, our event-study results indicate that the average announcement effect for convertible bonds issues between the Lehman Brothers collapse in September 2008 (which is often taken as a starting point of the crisis period) and December 2009 is almost twice as negative as in the Arbitrage period (−9.12%). Our evidence suggests that this very negative reaction can be attributed to the extremely high underpricing of crisis-period convertibles. While Arbitrage-period offerings are issued at an average discount of 15.7%, offering discounts for Post-Lehman offerings are more than twice as large (34.2% on average). Issuing highly underpriced convertibles may have been the only option for cash- and credit-constrained firms during the crisis.

To further strengthen our case for the arbitrage explanation for the evolution in convertible bond announcement effects, we also analyze post-issuance abnormal stock returns. If the observed negative announcement effects of Arbitrage-period convertibles are indeed partly attributable to hedging-induced price pressure, then we should observe a positive stock price reversal quickly after the convertible bond issue date. The reason is that, after a short time, the market should have absorbed the effect of the supply shock. Consistent with this prediction, we find significant positive abnormal stock returns following Arbitrage-period convertible bond issues, with the magnitude of the reversal significantly influenced by our constructed measure for the hedging demand associated with these offerings. Also in line with the arbitrage explanation, we find no evidence of such reversal for issues made during the Traditional Investor and Post-Lehman periods.

Our analysis provides the following two main contributions to the literature. First, our study sheds a new light on long-accepted stylized facts on the relative magnitude of

security offering announcement effects, by documenting that announcement-period returns associated with recent convertible offerings are far more negative than those for equity offerings. However, we also show that part of the highly negative "announcement" return associated with Arbitrage-period convertibles is actually caused by a short-lived stock price pressure induced by short-selling activities of convertible bond buyers. Our results imply that event studies using recent convertible bond offering announcements should correct for the influence of buy-side short selling associated with announced convertible bond issues. If not, they are likely to draw wrong (i.e., overly pessimistic) conclusions on the true magnitude of the transactions' impact on firm value.[2]

Second, our study contributes to a recent stream of corporate finance articles that explicitly take the influence of investor characteristics into account. As pointed out by Baker (2009), corporate finance studies have traditionally focused on the corporate supply side, thereby implicitly considering the investor side as a black box with perfectly elastic and competitive demand. However, a number of studies find that corporate finance actions can also be influenced through investor demand channels (e.g., Faulkender and Petersen, 2006; Leary, 2009; Lemmon and Roberts, 2010). Within this stream of literature, a limited number of papers document the impact of the actions of convertible bond arbitrageurs on convertible bond issuance volumes (Choi, Getmansky, Henderson, and Tookes, 2010; De Jong, Duca, and Dutordoir, 2010) and convertible bond design (Brown, Grundy, Lewis, and Verwijmeren, 2010; De Jong, Dutordoir, and Verwijmeren, 2010). Our study compliments these papers by examining the impact of buy-side shifts on stockholder wealth effects of convertible bond issues.

[2] Similarly, Mitchell, Pulvino, and Stafford (2004) show that almost half of the negative "announcement return" observed around fixed-exchange-ratio mergers is attributable to short-lived price pressure caused by the hedging transactions of merger arbitrageurs.

The remainder of the paper is structured as follows. The next section provides the theoretical background for our study. Section 3 describes the data and methodology. Section 4 discusses the empirical results. Section 5 concludes the paper.

2. Theoretical Background

In this section, we first briefly describe the two important shifts in the convertible bond investor base that occurred over the past decade. We then formulate our testable predictions on the impact of these shifts on the stockholder wealth effects of convertible bond offerings.

2.1. Shifts in the convertible bond investor base

Theoretical studies on convertible debt predict that convertibles are able to mitigate costs associated with attracting common equity and/or straight debt financing (Green, 1984; Brennan and Schwartz, 1988; Stein, 1992). Consistent with the hybrid debt-equity nature of convertible debt, event studies on the announcement effects associated with convertible debt offerings commonly find that these effects are negative and intermediate in size between the announcement effects associated with seasoned equity and straight debt offerings.[3]

The majority of these studies focus on a period in which convertible bond investors (e.g., mutual funds specialized in convertible bond investments) buy the convertibles without shorting the underlying stock. Around the beginning of the 21st century, however, the convertible bond investor base shifted from traditional long-only buyers towards convertible bond arbitrageurs (mostly hedge funds, but also institutional investors). By

[3] See Eckbo, Masulis, and Norli (2007) for an overview of the literature.

the beginning of the 21st century, hedge funds were purchasing up to 80% of new convertible issues (Brown et al., 2010).

The recent credit crisis, in turn, marked a substantial decline in the importance of convertible bond arbitrageurs as convertible bond investors. One of the reasons why arbitrage funds lost their grip on this market was the short sales ban affecting U.S. financial stocks between September 19, 2008 and October 8, 2008.[4] Other factors disadvantaging convertible arbitrage include widespread hedge fund redemptions, extensive deleveraging, and higher funding and borrowing costs (Credit Suisse/Tremont Hedge Index research report, May 2009).

The main goal of this paper is to examine the impact of these two important shifts in the involvement of convertible arbitrage funds on the stock price effects of convertible bond offerings. We distinguish three periods, each with a different involvement of convertible bond arbitrageurs. It is difficult to exactly indicate when convertible bond arbitrageurs became dominant players in the convertible bond market, because hedge funds do not disclose much information on their investments. To obtain more insight into the evolution of convertible arbitrage funds over time, we search the Factiva database for news sources that mention "convertible arbitrage" or related terms over the period 1984 to 2009.[5] Figure 1 provides the results of this search. The graph shows a sharp rise in the number of hits from 2000 onwards. This result is in line with Choi et al. (2009), who document a dramatic increase in the total assets under management of convertible bond

[4] See Beber and Pagano (2010) and Grundy, Lim, and Verwijmeren (2010) for a detailed discussion of the short sales ban.

[5] Factiva provides access to thousands of archived newspaper and magazine articles, as well as to press releases appearing on newswires.

hedge funds at the end of the 1990s.[6] We therefore use January 2000 as a cutoff date for the start of the Arbitrage period, in which the convertible bond investor base is dominated by convertible bond arbitrageurs, and label the previous window (from 1984 to December 1999) the Traditional Investor period.

It is also not straightforward to determine an exact date for the start of the financial crisis. As argued by Beber and Pagano (2010), the collapse of Lehman Brothers on September 15, 2008 is one of the most salient turning points in the course of events leading to the crisis. We therefore consider this date as the start of the third era, labeled "Post-Lehman" period.

[Please insert Figure 1 here]

2.2. Testable predictions

Unlike traditional long-only investors, convertible bond arbitrageurs generally short a portion of the common stock of the issuing firm to make their position invariant to small stock price movements. Their profits result from the fact that convertibles tend to be underpriced at issuance, and/or from their ability to exploit superior technology in managing convertible risk (Agarwal, Fung, Loon, and Naik, 2007).[7]

If demand curves for stock are not perfectly elastic, the increase in the supply of shares resulting from arbitrage-related short selling should induce downward stock price

[6] A Credit Suisse/Tremont Hedge Index research report dated May 2009 confirms that January 2000 is a reasonable cutoff date for the start of the Arbitrage period: "*Up until the year 2000, the convertible bond market was primarily driven by long-only buyers. Hedge funds entered the space in increasing numbers thereafter (…). The hedge fund influx represented a change in the buyer base*."

[7] Potential reasons for convertible debt underpricing include illiquidity, small issue size, and complexities associated with the valuation of hybrid securities (Lhabitant, 2002).

pressure around the convertible bond issuance date. A number of studies effectively find evidence of negative abnormal stock returns around convertible bond issue dates (Arshanapalli, Fabozzi, Switzer, and Gosselin, 2005; Loncarski, Ter Horst, and Veld, 2009; De Jong, Dutordoir, and Verwijmeren, 2010).

An important feature of recent convertible bond offerings is that they are placed very rapidly (often overnight), causing their announcement and issuance to be very close. The most important reason for this rapid placement is that most recent convertibles are structured as 144A offerings. Such offerings can be sold to selected institutional investors without having to incur time-consuming activities such as road shows and SEC filings.[8] As a result of the overlap between issuance and announcement dates, the observed "announcement" effect of convertible bond issues may partly reflect price pressure associated with the shorting activities of convertible arbitrageurs. Given the different levels of involvement of this investor class over the three eras considered in our study, we thus obtain the following hypothesis:

Hypothesis 1: Arbitrage-period convertibles induce more negative announcement-period stock returns than Traditional Investor- and Post-Lehman-period convertibles.

Stock market reactions to convertible bond announcements may be influenced by the characteristics of the issuer, the convertible bond design, as well as by macroeconomic

[8] One other reason why recent convertibles often have their issuance and announcement very closely together is that convertible arbitrage hedge funds tend to have a flexible, flat organization form, which enables them to decide very fast on whether they will include the convertible bond issue in their portfolio. In our empirical analysis, we include appropriate control variables for convertibles for which the announcement and issue dates coincide, as well as for 144A issues.

conditions at the moment of issuance (Lewis et al., 1999, 2003; Dutordoir and Van de Gucht, 2007; Krishnaswami and Yaman, 2008; Loncarski, Ter Horst, and Veld, 2008). Thus, any observed difference in the stockholder wealth effects of convertible bond offerings across the three periods may also be caused by temporal shifts in these determinants. We establish whether the differences in stockholder wealth effects across the three periods are effectively caused by temporal changes in buy-side characteristics by testing the following prediction:

Hypothesis 2: Differences in announcement-period returns between Arbitrage-period convertibles and Traditional Investor-/Post-Lehman-period convertibles disappear when controlling for arbitrage-related short selling associated with the convertible debt offering.

The arbitrage explanation for differences in stock price reactions across the three periods also yields a testable prediction on the stock price behavior shortly after the convertible bond offering. More particularly, if (part of) the negative stock price effect associated with Arbitrage-period convertibles is indeed caused by an increase in the supply of stock associated with arbitrage-related short selling, then we expect to observe a stock price reversal shortly after the issuance of these offerings. The underlying rationale is that demand curves for stock tend to be inelastic only in the short run, so stock prices should revert to their fundamental values once the market has absorbed the shock (Harris and Gurel, 1986). By contrast, in the Traditional Investor and Post-Lehman

periods, there should be no such stock price reversal. We thus obtain the following hypothesis:

Hypothesis 3: Convertible offerings made during the Arbitrage period are followed by a positive stock price reversal. No such reversal takes place in the Traditional Investor and Post-Lehman periods.

3. Data and Methodology

In this section, we first describe how we obtain the data sets of convertible, seasoned equity, and straight bond offerings. We then discuss our measure for the arbitrage-related short selling associated with convertible bond offerings, as well as the different control variables included in the analysis.

3.1. Convertible bond, equity, and straight bond samples

We obtain data for U.S. convertible debt, equity, and straight debt issued between January 1984 and December 2009 from the SDC Database. We exclude utilities (SIC codes 4900-4999) and financial firms (SIC codes 6000-6999), and consolidate multiple tranches of convertibles and straight debt offerings issued by the same firm on the same date. In the convertible bond sample, we only include "plain vanilla" convertible bonds (no exchangeable bonds, mandatory convertible bonds, or convertible preferred stock). In the equity sample, we only include seasoned common stock offerings made by the firm itself (no IPOs, no offerings made by existing shareholders, no preferred stock issues, no unit issues). We eliminate asset- and mortgage-backed bonds, depository notes, and bonds issued with warrants from the straight debt sample. We obtain a data set of 1,436

convertible bond issues, 4,885 equity issues, and 8,734 straight bond issues. There are 727 convertible issues in the Traditional Investor period, 645 convertible issues in the Arbitrage period, and 64 convertible issues in the Post-Lehman period.

We obtain company accounts variables from the Compustat Fundamentals Annual database, stock-price related data from the Center for Research in Security Prices (CRSP), deal-specific information from SDC, and macroeconomic data from Datastream.

3.2. Measure for arbitrage-related short selling

To test the arbitrage explanation for differences in convertible bond announcement returns across the three periods, we construct a measure for the amount of arbitrage-related short selling associated with each convertible bond offering. In a first step, we download monthly short interest data from the Securities Monthly file of the CRSP-Compustat merged database. These data are available from March 2003 until June 2008. To match short interest data to convertible bond issues, we apply the algorithm used by Bechmann (2004) and Choi et al. (2009). If a bond is issued before the cutoff trade date of a given month (i.e., three trading days prior to the 15th of each month), we match the issue date with the short interest data filed for that month. Otherwise, we match the issue date with the short interest data for the following month. As short interest is reported bi-monthly since September 2007, we adjust the algorithm to a two-monthly frequency from that month onwards. We scale the change in monthly short interest (ΔSI) by the number of shares outstanding (SO) measured on trading day –20. We find an average (median) value of 0.019 (0.014) for the ΔSI/SO ratio, which is similar to values recorded by Choi et al. (2009) and De Jong, Dutordoir, and Verwijmeren (2010).

As argued by Choi et al. (2009), part of the observed increase in short interest around convertible bond offerings may be attributable to the short-selling actions of fundamental traders. In a second step, we therefore need to isolate the portion of the ΔSI/SO measure that can effectively be attributed to the shorting actions of convertible bond arbitrageurs. We do this by regressing ΔSI/SO on a number of potential determinants of convertible arbitrageurs' interest in that particular convertible offering. We then take the predicted value for this regression as a measure for the change in short interest caused by arbitrage-related short selling (as opposed to fundamental short selling).[9]

A priori, we expect a convertible bond arbitrageur to be more interested in issuers with more liquid shares (since high liquidity makes it easier for arbitrageurs to obtain their hedging positions), high institutional ownership (since institutional investors are more likely to lend out their shares than individual investors), volatile stock returns (since volatility positively affects the option value of the convertible, thus allowing a higher potential profit), and no dividend payouts (since dividends represent a cash outflow for short sellers). We therefore include the Amihud (2002) measure for illiquidity, the percentage of institutional ownership, the stock return volatility, and a dummy variable equal to one for convertible debt issuers that paid out a dividend in the previous fiscal year in the regression analysis. Appendix A contains detailed definitions for these variables. Next to issuer characteristics, we also expect arbitrageurs' interest in a convertible bond issue to be affected by the characteristics of the offering itself. We predict a larger increase in arbitrage-related short interest around offerings for which arbitrageurs need to short-sell a larger number of shares to hedge their positions. We

[9] Mitchell et al. (2004) apply a similar procedure to isolate the portion of changes in short interest attributable to the hedging behavior of merger arbitrageurs.

therefore include the ratio of S_{arb} to shares outstanding, with S_{arb} representing the expected number of shares shorted by arbitrageurs under the assumption that the arbitrageurs follow a delta-neutral hedging technique.[10] S_{arb} depends on the convertible bond proceeds, the conversion ratio, and the equity component size of the offerings. Appendix B provides a more detailed description of this variable. We also expect arbitrageurs to be more interested in zero-coupon convertibles. The reason is that paying no coupons makes it easier to separate the option component of the convertible from its fixed-income component, which is a technique often applied by convertible arbitrage hedge funds.

Panel A of Table 1 provides descriptive statistics for these potential issuer- and issue-specific hedging demand determinants for the three periods.

[Please insert Table 1 here]

In the last column, we provide the results of *t*-tests for pairwise differences in the means across two periods. The letters a (b) indicate significant differences (at the 5% level) in the mean value between the Traditional Investor and the Arbitrage (Post-Lehman) period, and the letter c indicates a significant difference (at the 5% level) in the mean value between the Arbitrage and the Post-Lehman period. The Kruskal-Wallis *p*-value indicates the joint significance level of the difference in the variables across the three periods.

[10] Arguably, arbitrageurs may take other Greeks (e.g., gamma, vega) into account when deciding on their hedging positions. Still, most of the convertible arbitrage strategies build on the delta-neutral hedging technique (Calamos, 2003).

We find evidence of significant differences in the potential hedging demand determinants across the three periods. Most remarkably, the percentage of institutional ownership of convertible debt issuers increases substantially between the Traditional Investor and the Arbitrage period (from 41.4% to 71.5%), and the stock return volatility is almost twice as large for Post-Lehman issuers than for other issuers. It is also striking that, while approximately 7% of the convertibles issued during the first two periods have a zero-coupon structure, we find no zero-coupon offerings in the Post-Lehman period.

Panel B of Table 1 presents the results of a regression analysis of ΔSI/SO on the potential determinants of arbitrageurs' hedging demand. The analysis includes convertibles issued between 2003 and 2008 for which all necessary explanatory variables are available. In all regressions reported throughout the paper, we calculate *t*-statistics using White (1980) heteroskedasticity-robust standard errors.

Next to issuer- and issue-specific features, the reported regressions also include measures for temporal variations in the importance of convertible arbitrage activities. Such variations may occur due to fluctuations in macroeconomic conditions and/or in the capital available for investments in arbitrage funds. As a first proxy for temporal fluctuations in the importance of convertible bond arbitrageurs, we include the number of news sources in Factiva that mention "convertible arbitrage" or a related term over the three months prior to issuance (CAFactiva). One limitation of this measure is that it does not control for the actual content of the news source. Since both positive and negative developments regarding arbitrage funds may be newsworthy items, CAFactiva may be high both in periods in which arbitrageurs realize high profits (i.e., the Arbitrage period) and in periods with a high failure rate among convertible arbitrage funds (i.e., the Post-

Lehman era). Figure 1 suggests that this may indeed be the case, as the number of convertible arbitrage-related announcements remains high throughout the Post-Lehman era. In Column (2) of Panel B, we therefore include lagged capital flows into convertible arbitrage funds (CAFlows) over the quarter prior to issuance as an alternative proxy for temporal fluctuations in the activities of hedge funds. Appendix A provides a detailed description of the calculation of this variable. The CAFlows variable may be a more accurate measure than CAFactiva, but presents the disadvantage that it can only be obtained from 1994 onwards.

The R^2s of the regression specifications in Columns (1) and (2) indicate that, together, the arbitrage demand proxies are able to explain approximately 20% of the variation in short interest increases around convertible bond offerings. This result is consistent with the notion that part of the increase in short interest reflects trading patterns by fundamental traders rather than arbitrageurs. The regression results suggest that the expected number of shares shorted (Sarb/SO) is the most important determinant of arbitrageurs' hedging demand. The Amihud illiquidity measure also has a significant coefficient with the predicted negative sign, while the other variables have non-significant coefficients.

In a final step, we use the coefficients of the regression in Column (1) of Table 1 to obtain an estimate of the arbitrage-related change in short interest for each convertible debt offering issued over the period 1984 to 2009. That is, for each observation for which we have all explanatory variables available, we multiply the value of the regression coefficients by the values of the correspondent explanatory variables. The resulting value

represents the estimated change in short interest (relative to shares outstanding) caused by convertible arbitrageurs' short selling associated with that particular convertible bond.[11]

3.3. Control variables

Next to our hedging demand measure, we also include a number of issuer-specific variables in our analysis of convertible bond announcement returns. Appendix A provides a detailed definition of each of the control variables. All issuer characteristics included in the regression analyses are measured at fiscal year-end preceding the convertible debt announcement date, unless otherwise indicated.

Since convertibles encompass an equity component, we expect stockholder reactions to convertible debt announcements to be more negative for issuers with high equity-related financing costs. Similarly, due to the debt component embedded in convertible debt, we also expect convertible debt announcement returns to be more negative for issuers with high costs of attracting new debt financing.[12] In line with Lewis et al. (1999, 2003), we use the amount of slack capital and the pre-announcement stock runup (measured as the continuously-compounded non-market-adjusted daily stock return over trading days –60 to –2 relative to the announcement date) as proxies for the level of equity-related financing costs faced by the convertible debt issuers. When a firm with sufficient slack capital and/or a high stock runup issues equity, stockholders are more

[11] Findings remain similar when we use the coefficients in Column (2) for this purpose. The reason why we use Column (1) is that CAFactiva is available over the entire sample period, while CAFlows is only available from 1994 onwards.

[12] This prediction might seem at odds with the convertible debt rationale of Stein (1992), which states that convertibles can be used as tools to mitigate equity-related adverse selection costs. However, even though convertibles entail smaller equity-related financing costs than equity offerings, their equity component still induces an incremental increase in the level of equity-related costs of the issuing firm. Thus, *within* a convertible debt sample, we expect stockholder reactions to be more negative for issuers with high equity-related financing costs. An analogous reasoning applies for the impact of debt-related financing costs on convertible debt announcement returns.

likely to infer that this firm is overvalued. We thus expect both the slack capital and the pre-announcement stock runup to have a negative impact on stockholder reactions to convertible debt announcements. To capture the level of debt-related financing costs of the convertible debt issuers, we include the ratio of taxes paid to total assets and the ratio of long-term debt to total assets. In the finance literature, it is generally assumed that firms with a higher leverage ratio and a lower tax ratio face higher costs of attracting new debt financing (see, e.g., Lewis et al., 1999, 2003). Next to these specific equity- and debt-related costs measures, we also include four control variables that act as proxies for both equity- and debt-related financing costs. The volatility of the firm's stock expressed relative to the volatility on the S&P 500 index measures the level of asymmetric information associated with the firm, as well as the firm's riskiness. The market-to-book ratio may act as a proxy for growth opportunities (and as such be negatively associated with financing costs), but may also measure the potential for underinvestment and asymmetric information. As such, its predicted impact is unclear. Lastly, we include the ratio of fixed assets to total assets and the natural logarithm of total assets. Firms with a high proportion of fixed assets and/or a large size tend to have lower levels of asymmetric information relating to their value and risk, resulting in smaller equity- and debt-related financing costs (MacKie-Mason, 1990).

We also control for a number of issue-specific characteristics. We include the ratio of offering proceeds to total assets, since Krasker (1986) predicts that relatively larger equity(-linked) security offerings should result in more negative announcement returns. We include the delta (calculated as outlined in Appendix B) to control for the equity component size of the convertible bond issue. Following Myers and Majluf (1984), we

expect relatively more equity-like convertibles to induce more negative stockholder wealth effects. We also include a 144A dummy variable to disentangle the effect of the 144A private placement of convertibles from the effect of hedging-induced short selling, and an Issue=Announcement dummy variable equal to one for convertibles for which the issue date either coincides with the announcement date or falls on the trading day after the announcement date. Convertibles for which this is the case should be associated with more negative wealth effects in the window (−1, 1), since the announcement-period returns are more likely to capture hedging-induced price pressure.[13] We also control for convertible bond offering discounts (calculated as outlined in Appendix C). Offerings with higher discounts should be received less favorably by the market, since they imply a wealth transfer from existing shareholders to convertible bondholders.

Finally, we control for a number of standard macroeconomic determinants suggested by the literature, i.e., interest rates, term spreads, market returns, and market return volatilities. In the regressions, all macroeconomic determinants are lagged one quarter. Following a similar reasoning as for the issuer-specific variables, we expect stock price reactions to convertible debt announcements to be negatively influenced by proxies for aggregate financing costs. We thus expect a negative impact of interest rates, term spreads, and market return volatilities, since these variables act as proxies for the level of debt-related financing costs in the economy as a whole (Choe, Masulis, and Nanda, 1993; Korajczyk and Levy, 2003; Krishnaswami and Yaman, 2008). In turn, we

[13] Huang and Ramirez (2010) find no differences in announcement effects between public and Rule 144A issue markets for firms issuing convertible bonds in the period 1991-2004. In contrast to this result, Carayannopoulos and Nayak (2010) find that issuers of convertible bonds under Rule 144A experience a negative stock price reaction on the announcement day, over and above any reaction associated with public issues of convertible bonds.

expect a positive impact of market returns, since financing costs are assumed to be lower during market booms (Choe, Masulis, and Nanda, 1993).

Table 2 provides descriptive statistics for these control variables, and compares their average values across the three periods.

[Please insert Table 2 here]

The univariate test results indicate that Arbitrage-period issuers have a significantly larger slack and market-to-book ratio, and significantly smaller tax payments, relative stock return volatility, fixed assets, and total assets, than Traditional Investor-period issuers. With the exception of the finding on the stock return volatility, these results suggest that firms issuing convertibles during the Arbitrage period face higher external financing costs than pre-2000 issuers. Post-Lehman issuers also differ from those in the other periods on several dimensions, but the results do not provide a clear picture on the relative magnitude of their financing costs. On the one hand Post-Lehman issuers tend to have low tax levels and high debt levels, suggesting high debt-related financing costs, but on the other hand they tend to have low market-to-book ratios and a large firm size, which is consistent with low costs of attracting external financing.

While issue proceeds and delta are not significantly different between the Traditional Investor period and the Arbitrage period, Post-Lehman offerings are significantly smaller in size, and significantly more debt-like in nature (smaller delta). In line with Huang and Ramirez (2010), we find that the percentage of convertibles issued under Rule 144A increases dramatically in the beginning of this century. While only 9% of the Traditional

Investor-period issues are made under the Rule 144A regime, the percentage of Rule 144A issues increases to 85% in the Arbitrage period. In the Post-Lehman period this percentage drops back to approximately one-third of all offerings (34%). We also find a sharp increase in the percentage of offerings for which the announcement and issue date coincide, which is likely to be linked to institutional developments in the convertible debt market (increase in the importance of 144A offerings, and increase in hedge fund involvement). Finally, we observe substantial differences in convertible bond underpricing across the three periods. Traditional Investor-period offering discounts are significantly higher than those during the Arbitrage period. However, Arbitrage-period convertibles are still substantially underpriced (average offering discount of 15.7%), thus offering ample profit potential for convertible bond arbitrageurs. Post-Lehman offerings, in turn, are offered at discounts that are more than twice as large as the underpricing levels during the Arbitrage period (average offering discount of 34.2%). One possible explanation for this finding is that, during the crisis period, issuers that cannot obtain standard financing sources (e.g., due to serious restrictions on the possibility to obtain bank debt) use convertible bonds as a last-resort financing type. The exceptionally high underpricing levels may be necessary to convince risk-averse investors to include the convertibles in their portfolios.[14,15]

[14] In line with this intuition, a report by Calamos and Calamos (2008) states that convertible debt undervaluation levels were "*historically high*" as per October 2008, creating an "*incredible opportunity*" for convertible bond arbitrageurs. Of course we do realize that this text is included in a sales report for the Calamos convertible debt investment funds, and that the statements should be interpreted in this light. The "undervaluation" levels are probably also high in this period to compensate for high liquidity risk.

[15] In line with this intuition, the article "Companies return to convertibles" (Masters, Financial Times, May 11, 2009) mentions: "*The big shift came after last autumn's collapse of Lehman Brothers when bank lending dried up. Under pressure to cut their debt, many companies began looking for new sources of financing. Straight bond issues for companies with less than stellar credit ratings and those in cyclical sectors proved problematic - many would have to pay double-digit coupons and risk being rated at less than investment grade*."

We also find that most of the macroeconomic variables are significantly different across the three periods. Together, the descriptive results presented in Table 2 highlight the need to control for firm-specific, issue-specific, and macroeconomic financing costs measures when analyzing the source of the differences in abnormal stock returns between the three periods.

4. Empirical Results on Stockholder Wealth Effects of Convertible Bond Offerings

In this section, we provide the results of our empirical tests on the validity of the arbitrage explanation for changes in the stockholder wealth effects of convertible bond announcements. We first provide event-study results on the magnitude of the announcement effects of convertible bond, equity, and straight bonds over the three time periods. We then analyse the impact of arbitrage-related short selling on convertible bond announcement returns, while controlling for other announcement-return determinants. We conclude by examining stock price behavior following convertible bond offerings.

4.1. Stockholder wealth effects of convertible, equity, and straight debt announcements

We measure abnormal stock returns by applying standard event-study methodology as outlined in Brown and Warner (1985). We use the return over the CRSP equally-weighted market index as a proxy for the market return, and estimate the market model over the window (–240, –40) relative to the announcement date. In line with most existing event studies, we measure cumulative announcement returns (CARs) over the window (−1, 1) relative to the security offering announcement date. We assume that the public announcement of convertible debt offerings happens on the filing date obtained

from SDC.[16] However, this date is only available for publicly-placed convertible bond issues. For the remainder of the convertibles (754 in total), we manually look up the announcement date (identified as the date on which the offering is first mentioned) in Factiva. For equity offerings, we identify the announcement date as the filing date stated in SDC (available for virtually all of the offerings). For publicly-placed straight debt offerings, we also use the filing date. For straight debt issues for which the filing date is not available due to the fact that they are either structured as 144A offerings or privately placed (60.4% of the sample), we use the issue date obtained from SDC. Our findings remain similar when we exclude the straight debt issues for which we have no filing date available from the analysis. Table 3 provides the results of the event-study analysis for the three security types.

[Please insert Table 3 here]

During the Traditional Investor period, we observe security offering announcement effects that are similar in magnitude to those documented in prior studies (see Eckbo et al., 2007). This is no surprise since most prior event studies on security offerings also focus on issues made prior to 2000. Consistent with *Hypothesis 1*, we find that convertible bond announcement returns are significantly more negative during the Arbitrage Period than during the Traditional Investor Period (−4.59% compared with −1.69%), while equity and straight debt announcement returns remain fairly stable.

[16] We manually cross-checked the accuracy of the filing dates by verifying the actual announcement dates obtained from Factiva for 100 convertible bond issues. The results of this check indicate that SDC filing dates are accurate. However, some of the announcements are time-stamped after the closure of the stock market, which is why we also include day +1 in our analysis of convertible debt announcement returns.

However, inconsistent with *Hypothesis 1*, we find that Post-Lehman-period convertible bond announcement effects are significantly more negative than those in the previous two periods (–9.12%). Equity announcement returns are also slightly more negative over this period (–3.21%), but the magnitude of the change is much smaller than that for convertibles. Kruskal-Wallis *p*-values confirm that there are substantial differences in abnormal stock returns around convertible bond announcements across the three periods (*p*-value for differences in convertible bond wealth effects across the three periods is smaller than 0.001), while there are no such differences for equity and bond returns.

Figure 2 visualizes the evolution in security offering announcement effects over our research period by plotting quarterly average shareholder wealth effects for each of the three security types. The observed patterns are similar as those discussed in the context of Table 3: while equity and straight debt offering announcement effects remain fairly constant (except for a decrease in equity offering announcement effects during the Post-Lehman period), convertible debt announcement returns exhibit a declining trend. Returns sharply drop as of the beginning of the Arbitrage period, and fall even further at the beginning of the Post-Lehman period.

[Please insert Figure 2 here]

4.2. Determinants of stockholder wealth effects of convertible debt announcements

In a next step of the empirical analysis, we test whether the evolutions in convertible debt announcement returns documented in Table 3 and Figure 2 can effectively be attributed to changes in the convertible bond investor base (as predicted by *Hypothesis 2*).

Table 4 reports the results of regression specifications with the CAR over the window (−1, 1) relative to the convertible bond announcement date as dependent variable.

[Please insert Table 4 here]

Model (1) only includes a dummy variable equal to one for convertibles issued during the Arbitrage period (ArbPeriod), and a dummy variable equal to one for convertibles issued during the financial crisis (PostLehmanPeriod) on the right-hand side. Both variables have significantly negative regression coefficients. The differences between the periods are large in economic terms: the abnormal return in the Arbitrage Period is almost three percentage points lower than in the Traditional Investor period, and the abnormal return in the Post-Lehman period is more than seven percentage points lower than in the Traditional Investor period.

The significantly more negative CARs during the Arbitrage and Post-Lehman periods may be attributable to shifts in issuer, issue, and/or macroeconomic characteristics across the periods. For example, as shown in Table 2, Arbitrage-period issuers tend to have higher costs of attracting external financing, and may therefore receive more negative stockholder reactions to their convertible bond offering announcements. In Model (2), we therefore extend the regression with the control variables specified earlier. We find that the ArbPeriod and PostLehmanPeriod dummy variables still have significantly negative effects, but that the magnitude of their coefficients is only about half as large as in Model (1). This result suggests that the more negative announcement effects induced by recent convertible bond offerings are indeed partly attributable to changes in the control

variables. Consistent with this intuition, we find that the inclusion of the control variables results in a substantial increase in the adjusted R^2, from 7.40% to 10.12%.[17] CARs are significantly positively influenced by the market-to-book ratio, which is in line with results reported by De Jong, Dutordoir, and Verwijmeren (2010). In line with our expectations, we also find that abnormal returns are significantly negatively influenced by the issuer's relative volatility, the Issuance=Announcement dummy variable, the term spread, and the market return volatility.

One of the control variables included in Model (2) is a dummy variable equal to one for Rule 144A offerings. Denis and Mihov (2003) show that relatively more risky firms are more likely to opt for a Rule 144A offering. The coefficient of the Rule 144A dummy may thus be affected by an endogeneity bias if we include this variable as such in the regression analysis. Heckman (1979) demonstrates that such bias can be avoided by not only including the particular dummy variable in the regression analysis, but also including the Inverse Mills ratio. The inclusion of the Inverse Mills ratio corrects for the potential correlation between unobservable factors affecting both the decision to structure a convertible as a 144A offering and the stockholder reactions to convertible bond announcements, thus allowing us to obtain unbiased regression estimators in the abnormal return regression equation. As suggested by Heckman (1979), we first estimate a probit analysis with the 144A dummy variable as dependent variable, and with various control variables specified earlier on the right-hand side. The inverse Mills ratio (IMills) can be derived from this probit regression using the procedure outlined by Li and Prabhala (2007).

[17] We include industry dummies based on two-digit SIC codes as additional control variables in robustness tests, and find that our results remain similar. The industry dummies have low explanatory power. In fact, we find that the adjusted R^2 slightly decreases when we include industry dummies.

[Please insert Table 5 here]

Table 5 reports the results of the first-stage probit analysis. The dependent variable is equal to one for 144A offerings, and equal to zero otherwise.[18] We find that Rule 144A issues are made by firms with a significantly larger slack capital and firm size and significantly smaller taxes paid and fixed assets than non-Rule 144A issues. Furthermore, they have larger offering proceeds and a larger delta. We also find a significant negative impact of the interest rate and a significant positive impact of term spreads. Overall, the probit results suggest that the choice to structure a convertible bond offering as a Rule 144A issue is non-random, although we do not find direct evidence linking this choice to the firm's risk, as in Denis and Mihov (2003). Model (2) of Table 4 shows that convertible debt announcement effects are not significantly different for 144A convertibles (non-significant coefficient on the 144A dummy variable). This result corroborates results of Huang and Ramirez (2010), but goes against the results of Carayannopoulos and Nayak (2010). The coefficient on the Inverse Mills ratio is not significant either.

Hypothesis 2 implies that the differences in convertible bond announcement returns across the three periods should not longer be significant after controlling for differences in arbitrage-related short selling. In Model (3), we test this prediction by including the variable DemandArbitrage, which captures the predicted hedging demand from convertible bond arbitrageurs. DemandArbitrage is equal to the predicted increase in

[18] Almost all non-144A offerings are publicly placed (only 1.08% of the convertibles are privately placed without using Rule 144A).

short interest caused by arbitrage-related activities (calculated as outlined earlier) for convertibles issued during the Arbitrage period, and equal to zero for convertibles outlined in the other two periods. Model (3) thus relies on the assumption that there is no convertible arbitrage activity at all during the Traditional Investor and Post-Lehman periods. In line with *Hypothesis 2*, we find that the effect of the ArbPeriod dummy variable is no longer significantly negative after controlling for the price pressure caused by convertible bond arbitrage activity during the Arbitrage period. DemandArbitrage itself has a highly significant, negative effect on the CAR, which is consistent with the prediction that higher short selling is associated with stronger price pressure. However, inconsistent with *Hypothesis 2*, the impact of the PostLehmanPeriod dummy variable is still significantly negative in Model (3), suggesting that the highly negative CARs registered during the crisis period cannot (entirely) be ascribed to convertible arbitrage activities.

In Model (4), we relax the assumption that there is no arbitrage-related short selling at all outside the Arbitrage period by including two additional hedging demand variables. DemandTradInvestor is equal to the expected hedging demand for convertibles issued during the Traditional Investor period, and equal to zero otherwise. DemandPostLehman is defined in an analogous way for Post-Lehman offerings. The findings for our main variables of interest, ArbPeriod and PostLehmanPeriod, remain unaltered under this alternative scenario. ArbPeriod has a non-significant regression coefficient, while the impact of PostLehmanPeriod is significantly negative. With regards to the hedging demand proxies, we again find a significant negative impact for DemandArbitrage. We also find a significantly negative coefficient for DemandTradInvestor. The latter result is

consistent with the notion that even during the Traditional Investor period there was already some short-selling activity by convertible bond arbitrageurs, although the size of the coefficient is small relative to its size in the Arbitrage period. During the Post-Lehman period, by contrast, we do not find evidence of any price pressure caused by hedging activity (coefficient of DemandPostLehman is not significant). This finding is consistent with the severe restrictions on convertible arbitrage activities during that period.

Overall, we can conclude that the regression results pertaining to the Arbitrage period are in line with *Hypothesis 2* (i.e., the differences in CARs disappear when controlling for arbitrage-related short selling), while the regression results pertaining to the Post-Lehman period are not consistent with this hypothesis. One potential explanation for the highly negative announcement returns associated with crisis-period convertibles that we did not explore so far is their high initial underpricing reported in Table 3. In Model (5), we therefore augment Model (4) with the offering discount of the convertible bond offerings. Due to the limited availability of some of the input variables needed to calculate underpricing, we can only estimate this regression from 1991 onwards. We exclude the Rule144A and Issue=Announcement dummy variables because there are too few observations for which these dummy variables are zero over that time span.

We find that the coefficient on the PostLehmanPeriod dummy variable is no longer statistically significant after controlling for issue-date convertible bond underpricing. Hence, the more negative announcement effects of Post-Lehman offerings (relative to Traditional Investor-period convertibles) seem to be attributable to the large underpricing

of offerings in the Post-Lehman period.[19] The coefficient on the OfferingDiscount variable is significantly negative, which is consistent with the issuance of underpriced securities representing a wealth transfer from current shareholders to the buyers of the convertible securities. It could be questioned why companies issue such highly underpriced convertibles. One possible explanation is that they simply had no other choice, due to the very large difficulties in obtaining classic financing types such as bank debt during the financial crisis.

4.3. Stock returns following convertible bond offerings

To examine *Hypothesis 3*, we calculate CARs over the extended windows (2, 5) and (2, 10) following convertible bond issuance dates. The length of the windows is motivated by earlier studies showing that stock price reversals following arbitrage-related supply shocks tend to occur very fast (Harris and Gurel, 1986; Mitchell et al., 2004). Moreover, using longer windows would introduce too much noise in the abnormal return estimates (Wurgler and Zhuravskaya, 2002). Table 6 reports the results of this analysis.

[Please insert Table 6 here]

Panel A provides univariate results on the stock returns following convertible offerings in the three periods. In line with our arbitrage explanation for the highly

[19] The reduction in the significance of the effect of the PostLehmanPeriod dummy variable in Model (5) could also be attributable to the fact that we use a more narrow research period in this regression, due to the restrictions that the underpricing variable imposes on our sample period. We verify whether this is the case by re-running the regression in Model (4) for convertibles issued between 1991 and 2009. The untabulated results show that the Post-Lehman dummy variable is significantly negative even over this restricted window (*t*-statistic of –3.07), thus alleviating the concern that the change in its significance in Model (5) is mainly caused by a change in the research period.

negative stock price effects observed for Arbitrage-period convertibles, we find significantly positive post-issuance stock returns for offerings made during this period. The positive abnormal stock return of 0.54% over window (2, 10) represents approximately 12% of the absolute value of the announcement-period CAR (0.54/4.59). Thus, in line with previous studies (Dhillon and Johnson, 1991; Mazzeo and Moore, 1992; Lynch and Mendenhall, 1997; De Jong, Dutordoir, and Verwijmeren, 2010), our evidence suggests that there is only a partial reversal of the negative impact of the supply shock. However, it is hard to isolate the true magnitude of the reversal of the price pressure effect due to the fact that the CAR (−1, 1) simultaneously captures the effect of the signaling content of the convertibles (which should be permanent) and the effect of price pressure resulting from arbitrage trading (which should be temporary, at least if demand curves for stock are only inelastic in the short run).

Also in line with *Hypothesis 3*, we find no evidence of a positive stock price reversal in the Traditional Investor and Post-Lehman periods. Abnormal stock returns over the window (2, 10) are even significantly negative during both periods. The finding of negative post-issuance returns is consistent with Lewis, Rogalski, and Seward (2001), who report long-run stock price underperformance following convertible debt issuance over longer investment horizons.

In Panel B, we regress post-issuance stock price returns on our measures for arbitrage-related increases in short interest.[20] We also include the Amihud illiquidity measure, since price reversals should be stronger for more illiquid stocks (Bagwell, 1992). If the positive stock price reversal following Arbitrage-period convertibles is

[20] The number of observations in Panel B drops slightly compared to Panel A because data are not available for all explanatory variables.

indeed related to the supply shock caused by arbitrage-induced short selling, we expect this reversal to be stronger for convertibles attracting a higher hedging demand. In line with this prediction, we find a significant positive impact of our constructed hedging demand measure for the Arbitrage period (DemandArbitrage) on stock price reactions over windows (2, 5) and (2, 10). Also consistent with our expectations, the coefficients on the corresponding hedging demand measures for the Traditional Investor and Post-Lehman periods are not significant. Overall, the findings on stock price behavior following convertible debt issues are thus consistent with *Hypothesis 3*.

5. Summary and Conclusions

Over the past decades, the convertible bond market has experienced a substantial shift in its buyer base. In this paper, we show that this shift has important implications for the stockholder wealth effects registered around convertible bond announcements. We distinguish three different periods. The first period (1984-1999) is characterized by traditional investors who take long positions in convertible bonds. In the second period (2000 to September 14, 2008) the majority of convertible buyers are convertible arbitrageurs that combine a long position in convertibles with short positions in the underlying stock. In the third period (September 15, 2008 to 2009), hedge funds partly lose their grip on the convertible bond market. We find strong differences in convertible bond announcement effects between these three periods. In the Traditional Investor period, the average abnormal return is −1.69%, which is below the average abnormal return associated with a common stock issue (−2.34%). This result corresponds to findings of previous event studies, and is widely interpreted as evidence for the signaling

model of Myers and Majluf (1984). In the Arbitrage period, stockholder wealth effects of convertible bond announcements decrease to −4.59%, while straight debt and equity announcement returns remain fairly constant. Our results provide two non-mutually exclusive explanations for this sharp drop in announcement effects. First, part of the negative "announcement" effect is caused by price pressure associated with arbitrage-related short selling of convertible hedge funds. Second, we find that part of the more negative announcement effect registered during the Arbitrage period can be attributed to changes in firm-specific, security design, and macroeconomic characteristics over time.

An interesting question is why firms have continued to issue convertible securities in the Arbitrage period after managers observed the negative price effects surrounding these issues. We attempt to answer this question by examining post-issue effects, and we show that the negative price effect upon issuance in the arbitrage period partly reverses after the convertible bond offering. An additional motivation for why firms continued to sell convertibles to hedge funds is that these funds can use their expertise in short-selling to distribute equity exposure to a large number of well-diversified investors, which makes hedge funds relatively low-cost distributors of equity exposure for the firm (Brown et al., 2010).

During the financial crisis, we observe a further decrease in the abnormal returns around convertible bond announcements (−9.12%), while abnormal returns around equity announcements decrease to a much smaller extent (−3.21%) and abnormal returns around straight debt announcements remain virtually unchanged. The very negative convertible bond announcement returns are surprising given the smaller involvement of convertible arbitrage funds during this period. We find that the high underpricing of Post-Lehman

convertibles plays a role in explaining the much more negative stockholder wealth effects associated with these securities.

Our results suggest that event studies on recent convertible bond announcements need to take the price pressure caused by convertible arbitrage strategies into account if they want to obtain unbiased estimates of the signaling content of convertibles. Our findings also highlight the need to control for convertible bond underpricing when analyzing stock price reactions to convertible bond announcements.

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Table 1: Construction of our measure for arbitrage-related short selling

Panel A shows summary statistics for the potential determinants of the arbitrage-related short selling associated with a convertible bond offering. Variables are defined as outlined in Appendix A and B. The Traditional Investor period ranges from 1/1/1984 to 31/12/1999 and refers to the period before the surge in convertible arbitrage hedge funds, while the Arbitrage period ranges from 1/1/2000 to 14/9/2008 and refers to the period when convertible arbitrageurs were the predominant purchasers of convertible debt issues. The Post-Lehman period ranges from 15/9/2008 to 31/12/2009 and refers to the period following the collapse of Lehman Brothers. The Kruskal-Wallis test is used to test for the differences of the characteristics between all three sub-periods. The independent sample *t*-test (assuming unequal variances) is used to test for the equality of means across any two sub-periods. Pairs for which the difference is statistically significant at at least the 5% level are indicated by the letters a, b, or c, where a indicates a significant difference between the Traditional Investor period and the Arbitrage period, b indicates a significant difference between the Traditional Investor period and the Post-Lehman period, and c indicates a significant difference between the Arbitrage period and the Post-Lehman period. Panel B presents the results of an OLS regression analysis that estimates the arbitrage-related change in short interest over the period 01/01/2003 to 14/09/2008. The dependent variable ΔSI/SO is the change in monthly short interest divided by shares outstanding over the month around the issue date. *t*-statistics, calculated using White (1980) heteroskedasticity-robust standard errors, are in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively. N denotes the number of observations.

Panel A: Summary statistics for issuer- and issue-specific determinants of arbitrage-related short selling

Variable	Traditional Investor Period (N =727)			Arbitrage period (N=645)			Post-Lehman period (N=64)			Kruskal-Wallis *p*-value	*t*-test for difference in means
	Average	Median	Std. Dev.	Average	Median	Std. Dev.	Average	Median	Std. Dev.		
Amihud	0.260	0.029	1.395	0.013	0.002	0.040	0.159	0.024	0.703	0.000	a,b,c
InstitOwnership	0.414	0.406	0.229	0.715	0.752	0.217	0.754	0.808	0.231	0.000	a,b
Volatility	0.443	0.405	0.173	0.551	0.491	0.247	1.063	0.994	0.593	0.000	a,b,c
DividendPaying	37.451%			20.411%			25.609%				
S_{arb}/SO	0.169	0.130	0.165	0.103	0.089	0.069	0.145	0.095	0.296	0.000	a
ZeroCoupon	7.290%			7.878%			0.000%				

Panel B: Regression analysis of ΔSI/SO on potential determinants of arbitrage-related short selling

Variable	Parameter estimate (*t*-value)	
	(1)	(2)
Amihud	−0.01**	−0.02*
	(−2.08)	(−1.86)
InstitOwnership	0.01	0.00
	(1.06)	(0.39)
Volatility	−0.01	0.00
	(−1.60)	(0.24)
DividendPaying	0.00	0.00
	(1.11)	(0.82)
S_{arb}/SO	0.15***	0.14***
	(8.08)	(7.35)
ZeroCoupon	0.00	0.00
	(0.09)	(0.16)
CAFactiva	−0.00	
	(−1.47)	
CAFlows		0.02
		(0.36)
Intercept	0.01	0.01
	(0.99)	(0.99)
Adj. R^2	18.72%	18.92%
R^2	20.01%	20.64%
N	440	330
Period	2003-2008	2003-2008

Table 2: Summary statistics for potential determinants of convertible bond announcement effects

This table provides descriptive statistics for firm-specific, issue-specific and macroeconomic variables across periods. Variables are defined as outlined in Appendix A and C. The Traditional Investor period ranges from 1/1/1984 to 31/12/1999 and refers to the period before the surge in convertible arbitrage hedge funds, while the Arbitrage period ranges from 1/1/2000 to 14/9/2008 and refers to the period when convertible arbitrageurs were the predominant purchasers of convertible debt issues. The Post-Lehman period ranges from 15/9/2008 to 31/12/2009 and refers to the period following the collapse of Lehman Brothers. The Kruskal-Wallis test is used to test for the differences of the characteristics between all three periods. The independent sample *t*-test (assuming unequal variances) is used to test for the equality of means across any two sub-periods. Pairs for which the difference is statistically significant at (at least) the 5% level are indicated by the letters a, b, or c, where a indicates a significant difference between the Traditional Investor period and the Arbitrage period, b indicates a significant difference between the Traditional Investor period and the Post-Lehman period, and c indicates a significant difference between the Arbitrage period and the Post-Lehman period. N denotes the number of observations.

Variable	Traditional Investor Period (N =727)			Arbitrage period (N=645)			Post-Lehman period (N=64)			Kruskal-Wallis *p*-value	*t*-test for difference in means
	Average	Median	Std. Dev.	Average	Median	Std. Dev.	Average	Median	Std. Dev.		
Firm characteristics											
StockRunup	0.171	0.151	0.214	0.172	0.130	0.275	0.314	0.251	0.493	0.015	b,c
Slack	0.142	0.067	0.173	0.229	0.142	0.236	0.151	0.092	0.188	0.000	a,c
Tax	0.030	0.025	0.033	0.019	0.012	0.035	0.012	0.006	0.051	0.000	a,b
LTDebt	0.214	0.201	0.167	0.214	0.207	0.183	0.283	0.284	0.194	0.000	b,c
RelVolatility	3.744	3.128	2.435	3.246	3.039	1.419	4.480	4.968	2.515	0.000	a,c
MarkettoBook	3.419	2.350	5.628	4.460	2.710	6.395	2.266	1.487	3.496	0.000	a,b,c
FixedAssets	0.334	0.290	0.217	0.250	0.165	0.228	0.332	0.219	0.274	0.000	a,c
LogAssets	5.433	5.319	1.514	4.460	2.710	6.395	6.398	6.987	1.716	0.000	a,b,c
Issue characteristics											
Proceeds	0.400	0.289	0.424	0.359	0.224	0.462	0.129	0.078	0.132	0.000	b,c
Delta	0.791	0.842	0.191	0.791	0.843	0.157	0.658	0.658	0.152	0.000	b,c
144A	9.491%			84.651%			34.375%				
Issue=Announcement	25.722%			88.372%			95.313%				
OfferingDiscount	0.215	0.219	0.090	0.157	0.150	0.131	0.342	0.340	0.102	0.000	a,b,c
Macroeconomic characteristics											
InterestRate	4.919	4.650	1.471	1.836	1.943	0.974	3.643	3.274	1.177	0.000	a,b,c
TermSpread	2.023	1.900	0.963	1.653	1.853	1.300	2.906	2.827	0.374	0.000	a,b,c
MarketRunup	0.058	0.057	0.059	0.019	0.024	0.070	0.041	0.055	0.136	0.000	a
MarketVolatility	0.132	0.130	0.036	0.160	0.159	0.059	0.312	0.353	0.105	0.000	a,b,c

Table 3: Univariate analysis of convertible debt, equity, and straight debt announcement effects

This table shows average and median cumulative abnormal stock returns (CARs) measured over the window (−1, 1) relative to the announcement date for samples of convertible debt, equity, and straight debt offerings. CARs are calculated using standard event-study methodology. CARsCD are the CARs of convertible debt issuers. CARsEQ are the CARs of seasoned equity issuers. CARsSD are the CARs of straight debt issuers. The Traditional Investor period ranges from 1/1/1984 to 31/12/1999 and refers to the period before the surge in convertible arbitrage hedge funds. The Arbitrage period ranges from 1/1/2000 to 14/9/2008 and refers to the period when convertible arbitrageurs were the predominant purchasers of convertible debt issues. The Post-Lehman period ranges from 15/9/2008 to 31/12/2009 and refers to the period following the collapse of Lehman Brothers. The Kruskal-Wallis test is used to test for differences between the CARs across all three sub-periods. The Patell *Z*-test is used to test the hypothesis that the individual CARs are equal to zero. *, **, *** indicate significance of the Patell *Z*-test statistic at the 10%, 5%, and 1% level, respectively. N denotes the number of observations.

Variable	Traditional Investor Period		Arbitrage period		Post-Lehman period		Kruskal-Wallis *p*-value
	Average	Std.Dev	Average	Std.Dev	Average	Std.Dev	
CARsCD(−1, 1)	−1.69%***	5.07%	−4.59%***	7.20%	−9.12%***	9.41%	0.00
N	727		645		64		
CARsEQ(−1, 1)	−2.34%***	6.13%	−2.67%***	7.68%	−3.21%***	11.67%	0.27
N	3,579		1,143		163		
CARsSD(−1, 1)	−0.09%*	3.67%	−0.04%	3.99%	−0.40%**	5.94%	0.06
N	5,662		2,692		380		

Table 4: Regression analysis of determinants of convertible debt announcement returns

This table presents the results of a regression analysis of announcement-period cumulative abnormal stock returns (CARs) of convertible offerings on a number of potential determinants. The dependent variable in the regression is the cumulative abnormal stock return measured over the window (−1, 1) relative to the announcement date, and is calculated using standard event-study methodology. ArbPeriod is a dummy variable that takes a value of one for announcements made in the Arbitrage period. PostLehmanPeriod is a dummy variable that takes a value of one for announcements made in the Post-Lehman period. InverseMills is the Inverse Mills ratio calculated from the probit regression in Table 5. DemandTradInvestor is equal to the estimated arbitrage-related increase in short interest relative to shares outstanding (calculated using the regression in Column (1) of Table 1) for issues made in the Traditional Investor period, and equal to zero for issues made during other periods. DemandArbitrage and DemandPostLehman are defined in an analogous way for issues made during the Arbitrage period and the Post-Lehman period, respectively. All other explanatory variables are defined as outlined in Appendix A and C. *t*-statistics, calculated using White (1980) heteroskedasticity-robust standard errors, are in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively. N denotes the number of observations.

Variable	Parameter estimate (*t*-value)				
	(1)	(2)	(3)	(4)	(5)
Period indicators					
ArbPeriod	−2.83***	−1.70**	1.51	1.45	1.09
	(−8.30)	(−2.40)	(1.53)	(1.44)	(0.88)
PostLehmanPeriod	−7.16***	−4.03***	−3.54***	−3.33**	−4.05
	(−6.25)	(−2.75)	(−2.37)	(−2.08)	(−1.49)
Firm characteristics					
StockRunup		−0.15	−0.62	−0.56	−0.51
		(−0.14)	(−0.60)	(−0.52)	(−0.37)
Slack		−1.31	−2.43	−2.44	−1.87
		(−0.86)	(−1.60)	(−1.57)	(−1.17)
Tax		2.05	3.24	1.23	−1.67
		(0.26)	(0.41)	(0.15)	(−0.18)
LTDebt		−1.46	−0.03	0.25	0.13
		(−1.09)	(−0.02)	(0.17)	(0.08)
RelVolatility		−0.37**	−0.46**	−0.55***	−0.08
		(−2.02)	(−2.43)	(−2.77)	(−0.28)
MarkettoBook		0.07*	0.02	0.02	−0.01
		(1.79)	(0.60)	(0.47)	(−0.23)
FixedAssets		0.01	0.10	−0.12	−0.66
		(0.01)	(0.08)	(−0.09)	(−0.58)
LogAssets		0.32	−0.09	0.07	0.45*
		(0.70)	(−0.20)	(0.15)	(1.87)
Issue characteristics					
Proceeds		0.19	0.34	0.88	1.72*
		(0.21)	(0.39)	(0.95)	(1.66)
Delta		−0.01	−0.70	−0.11	−1.28
		(0.00)	(−0.39)	(−0.06)	(−0.74)
144A		0.34	0.34	0.47	
		(0.58)	(0.57)	(0.77)	
InverseMills		−0.10	−0.92	−0.59	
		(−0.08)	(−0.74)	(−0.46)	
Issue=Announcement		−0.91**	−0.91**	−0.91**	−0.91**
		(−2.14)	(−2.14)	(−2.14)	(−2.14)
OfferingDiscount					−4.45*
					(−1.82)

Table 4 (Continued)

Macroeconomic characteristics					
$InterestRate_{t-1}$		0.39	0.56	0.54	0.72**
		(1.15)	(1.62)	(1.52)	(2.22)
$TermSpread_{t-1}$		−0.43***	−0.45***	−0.44***	−0.36*
		(−2.67)	(−2.74)	(−2.62)	(−1.91)
$MarketRunup_{t-1}$		−0.30	0.61	0.30	3.93
		(−0.10)	(0.20)	(0.09)	(0.92)
$MarketVolatility_{t-1}$		−11.98***	−13.37***	−15.04***	−11.57**
		(−2.95)	(−3.20)	(−3.49)	(−2.02)
Arbitrage-related shorting activity					
DemandTradInvestor				−8.38***	−38.88
				(−3.96)	(−1.42)
DemandArbitrage			−164.73***	−168.07***	−166.67***
			(−4.64)	(−4.67)	(−4.18)
DemandPostLehman				−7.45	43.43
				(−0.47)	(0.23)
Intercept	−1.69***	−1.16	2.79	1.45	−2.80
	(−9.11)	(−0.25)	(0.60)	(0.30)	(−0.97)
Adj. R^2	7.40%	10.12%	11.94%	12.41%	10.20%
N	1,476	1,476	1,476	1,476	788
Period	1984-2009	1984-2009	1984-2009	1984-2009	1991-2009

Table 5: Regression analysis of the determinants of 144A issues
This table presents the results of a probit regression with as dependent variable a dummy variable that takes the value of one for a 144A issue and zero for all other (mostly publicly-placed) convertible bond offerings. All explanatory variables are defined as outlined in Appendix A. *t*-statistics, calculated using Huber-White robust standard errors, are in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively. N denotes the number of observations.

Variable	Parameter estimate (*t*-value)
Firm characteristics	
StockRunup	0.15
	(0.96)
Slack	1.24***
	(4.91)
Tax	−5.09***
	(−4.33)
LTDebt	−0.83
	(−3.26)
RelVolatility	0.27
	(1.57)
MarkettoBook	0.01
	(0.84)
FixedAssets	−1.19***
	(−6.34)
LogAssets	0.49***
	(13.91)
Issue characteristics	
Proceeds	0.57***
	(4.10)
Delta	1.66***
	(6.44)
Macroeconomic characteristics	
$InterestRate_{t-1}$	−0.30***
	(−13.48)
$TermSpread_{t-1}$	0.10***
	(3.10)
$MarketRunup_{t-1}$	0.07
	(0.12)
$MarketVolatility_{t-1}$	−0.40
	(−0.57)
Intercept	−3.77***
	(−10.09)
Adj. R^2	38.29%
N	1,476
Period	1984-2009

Table 6: Analysis of stock returns following convertible debt issues

This table analyses average cumulative abnormal stock returns (CARs) following convertible bond issuance, computed using standard event-study methodology. The windows are measured relative to the convertible bond issuance date. The Traditional Investor period ranges from 1/1/1984 to 31/12/1999 and refers to the period before the surge in convertible arbitrage hedge funds. The Arbitrage period ranges from 1/1/2000 to 14/9/2008 and refers to the period when convertible arbitrageurs were the predominant purchasers of convertible debt issues. The Post-Lehman period ranges from 15/9/2008 to 31/12/2009 and refers to the period following the collapse of Lehman Brothers. In Panel A, the Kruskal-Wallis test examines differences between the CARs over the three sub-periods. The Patell *Z*-test examines the hypothesis that the individual CARs are equal to zero. Panel B presents the results of a regression analysis of the CARs following convertible bond issuance on a number of potential determinants. DemandTradInvestor is equal to the estimated arbitrage-related increase in short interest relative to shares outstanding (calculated using the regression in Column (1) of Table 1) for issues made in the Traditional Investor period, and equal to zero for issues made during other periods. DemandArbitrage and DemandPostLehman are defined in an analogous way for issues made during the Arbitrage period and the Post-Lehman period, respectively. Explanatory variables are defined as outlined in Appendix A. *t*-statistics, estimated using White (1980) heteroskedasticity-robust standard errors, are in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively. N denotes the number of observations.

Panel A: Univariate analysis of abnormal stock returns following convertible bond issuance

Variable	Traditional Investor Period		Arbitrage period		Post-Lehman period		Kruskal - Wallis *p*-value
	Average	Std.Dev	Average	Std.Dev	Average	Std.Dev	
CARs(2,5)	−0.02%	5.26%	0.50%***	6.11%	−1.85%	11.52%	0.00
CARs(2,10)	−0.46%**	8.25%	0.54%***	8.79%	−3.39%*	11.49%	0.00
N	727		645		64		

Panel B: Regression analysis of abnormal stock returns following convertible bond issuance

Variable	Parameter estimate (*t*-value)	
	CARs(2,5) (1)	CARs(2,10) (2)
DemandTradInvestor	2.19	5.44
	(0.22)	(0.30)
DemandArbitrage	46.67***	58.97***
	(2.75)	(0.39)
DemandPostLehman	−33.68	−34.47
	(−0.97)	(−0.52)
Amihud	0.04	0.28
	(1.15)	(0.54)
Intercept	−0.24	−0.56
	(−0.71)	(−1.17)
Adj. R^2	0.58%	0.33%
N	1,422	1,422
Period	1984-2009	1984-2009

Figure 1: **Quarterly number of convertible arbitrage-related articles appearing in the Factiva database**
This figure shows the number of news sources (i.e., articles or press releases) containing any of the terms "convertible arbitrage", "convertible debt arbitrage", "convertible bond arbitrage", "convertible arbitrageur", "convertible debt arbitrageur", "convertible bond arbitrageur", "convertible arbitrageurs", "convertible debt arbitrageurs", or "convertible bond arbitrageurs" in Factiva in any given quarter over the period 1984 to 2009. To avoid double-counting, we exclude instances where the same article appears more than once.

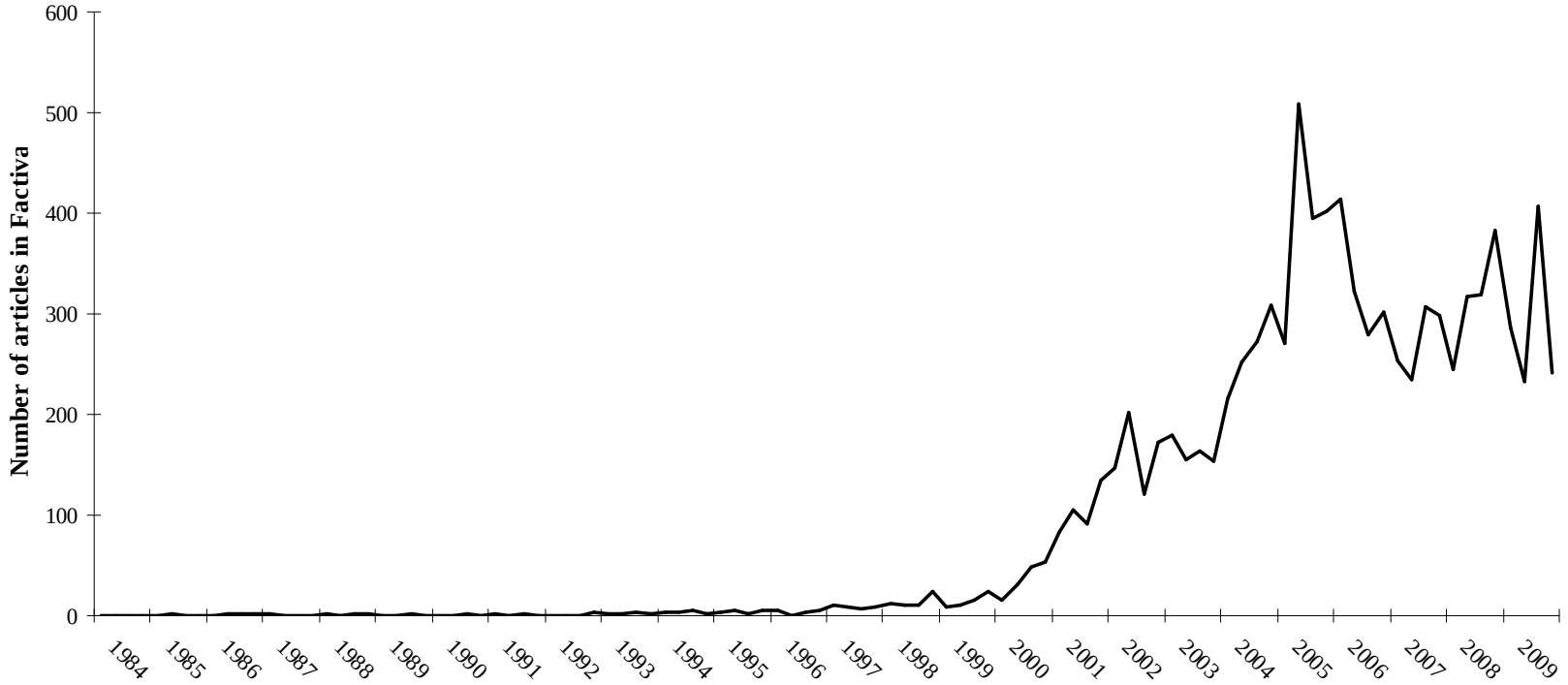
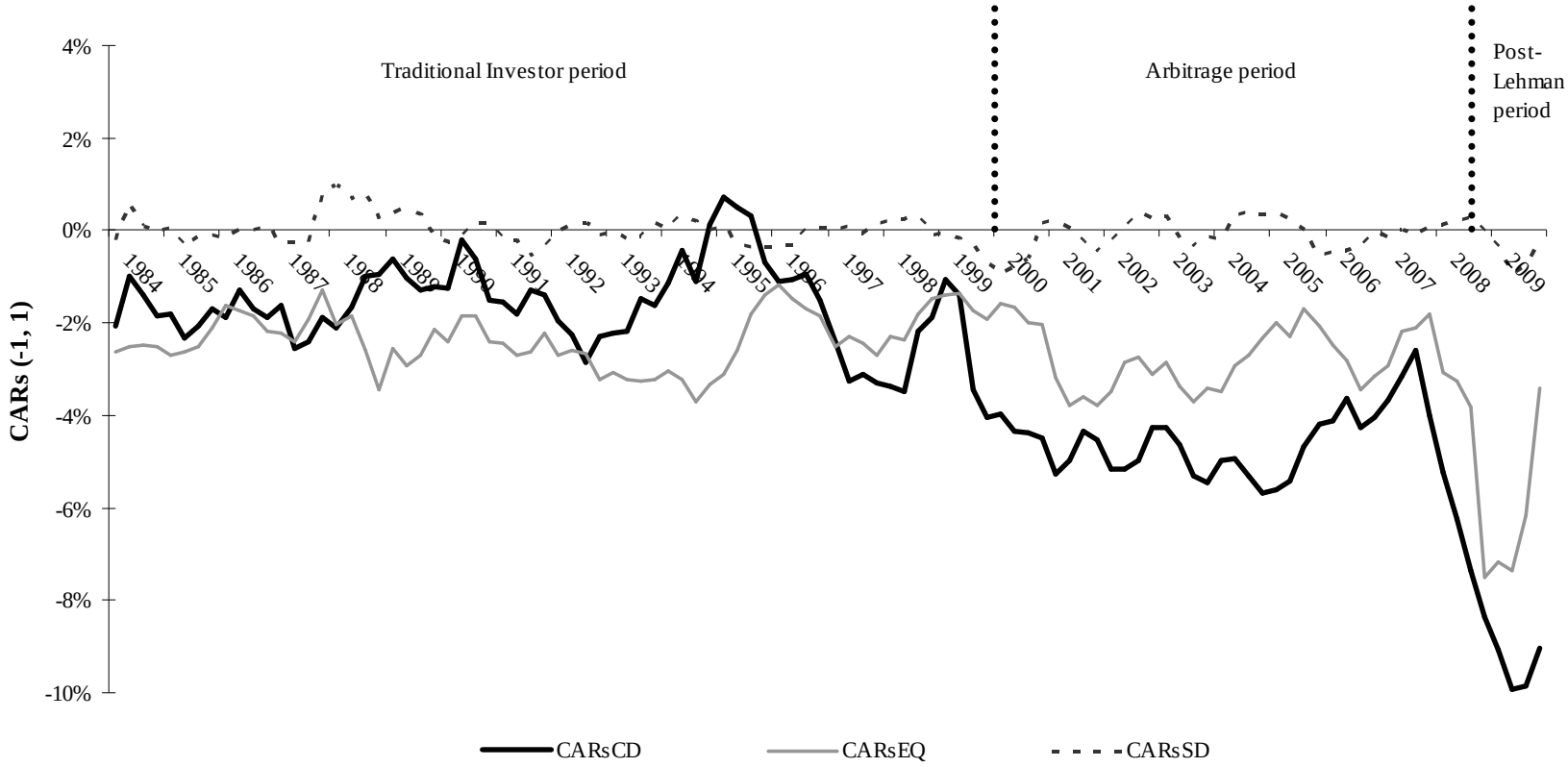


Figure 2: Average quarterly shareholder wealth effects of convertible, equity and straight debt announcements

This figure shows average quarterly cumulative abnormal stock returns (CARs) for security offering announcements between January 1984 and December 2009. We calculate abnormal returns for each security announcement over the window (−1, 1) relative to the announcement date using standard event-study methodology, and then average across security offering announcements made in the same quarter. We take the moving average of four quarters to smooth the time series of announcement effects. CARsCD are the CARs of convertible debt issuers. CARsEQ are the CARs of seasoned equity issuers. CARsSD are the CARs of straight debt issuers The Traditional Investor period ranges from 1/1/1984 to 31/12/1999 and refers to the period before the surge in convertible arbitrage hedge funds. The Arbitrage period ranges from 1/1/2000 to 14/9/2008 and refers to the period when convertible arbitrageurs were the predominant purchasers of convertible debt issues. The Post-Lehman period ranges from 15/9/2008 to 31/12/2009 and refers to the period following the collapse of Lehman Brothers.



Appendix A: Detailed description of variable calculations

Determinants of arbitrage-related short selling

Variable name	Calculation
Amihud	Amihud (2002) illiquidity measure, calculated as the ratio of the absolute value of daily stock returns divided by trading volumes averaged over the window (−120, −20) relative to the convertible bond announcement date. For expositional purposes, we multiply this ratio by 10^6.
InstitOwnership	Number of shares held by 13F institutions (obtained from Thomson Reuters), divided by the number of shares outstanding (both measured at the fiscal year-end prior to the convertible bond announcement date).
Volatility	Annualized stock return volatility, estimated from daily stock returns over the window (−240, −40) relative to the convertible bond announcement date.
DividendPaying	Dummy variable equal to one if the convertible bond issuer paid out a dividend over the previous fiscal year, which can be established through Compustat #26.
S_{arb}/SO	The number of shares that need to be shorted for arbitrageurs to obtain a delta-neutral position as of the issuance date, divided by the number of shares outstanding measured at the fiscal year-end prior to the convertible bond announcement date. S_{arb} is calculated as outlined in Appendix B.
ZeroCoupon	Dummy variable equal to one for zero-coupon convertibles.
CAFactiva	Number of news sources in Factiva mentioning "convertible arbitrage" or a related search term (as outlined in Figure 1), calculated over the quarter preceding the convertible bond announcement date.
CAFlows	Flows into convertible arbitrage hedge funds over the quarter prior to the convertible bond issuance quarter. We obtain data on flows into convertible bond arbitrage hedge funds from the TASS Live and Graveyard databases, which provide coverage from 1994 onwards. We select those funds that state convertible arbitrage as their primary investment category and that have a U.S.-oriented geographical focus (164 in total). We measure hedge fund flows in a similar way as Choi et al. (2010). First, we calculate dollar flows for each fund using the change in total net assets over the quarter, adjusted for the returns of the fund. We then aggregate flows and total net assets across funds for each quarter and divide the change in total flows by total lagged assets to obtain percentage quarterly fund flows.

Firm characteristics (measured at fiscal year-end preceding the convertible debt offering announcement date, unless specified otherwise; # refers to a data item in the Compustat Fundamentals Annual database).

Variable name	Calculation
StockRunup	Stock return over the window (−60, −2) relative to the announcement date.
Slack	Cash and short-term investments (#1) divided by total assets (#6).
Tax	Income taxes paid (#16) divided by total assets (#6).

LTDebt	Long-term debt (#9) divided by total assets (#6).
RelVolatility	Annualized stock return volatility, estimated from daily stock returns over the window (−240, −40) relative to the convertible bond announcement date, divided by the annualized standard deviation of the S&P 500 index (obtained from Datastream) calculated over the same period.
MarkettoBook	Market value (calculated as #25 multiplied by #199) divided by the book value of common equity (#60).
FixedAssets	Plant, property, and equipment (#8) divided by total assets (#6).
LogAssets	Natural logarithm of total assets (#6), deflated by the Consumer Price Index (obtained from Datastream).
Issue characteristics	
Variable name	Calculation
Proceeds	Relative size of the convertible bond offering, calculated as the offering proceeds divided by total assets (#6).
Delta	Sensitivity of the convertible bond value to its underlying common stock value, measured as outlined in Appendix B.
144A	Dummy variable that takes the value one for offerings made under SEC Rule 144A.
Issue=Announcement	Dummy variable that takes the value one when the issue date and announcement date coincide, or when the issue date falls one trading day after the announcement date.
OfferingDiscount	Underpricing of the convertible bond as of its issuance date, measured as outlined in Appendix C.
Aggregate financing costs measures	
Variable name	Calculation
InterestRate	Difference between yields on ten-year U.S. Treasury Bonds and the inflation rate (measured as the continuously-compounded annual change in the U.S. Consumer Price Index), averaged over the quarter prior to issuance.
TermSpread	Difference between yields on ten-year U.S. Treasury Bonds and three-month Treasury Bills, averaged over the quarter prior to issuance.
MarketRunup	Return on the S&P 500 index over the quarter prior to issuance.
MarketVolatility	Annualized market return volatility, calculated from daily returns on the S&P 500 index over the quarter prior to issuance.

Appendix B: Calculation of number of shares expected to be shorted by arbitrageurs (S_{arb})

S_{arb} represents the number of shares expected to be shorted by arbitrageurs, under the assumption that arbitrageurs follow a delta-neutral hedging strategy. In line with De Jong, Dutordoir, and Verwijmeren (2010), we calculate S_{arb} as follows:

$$S_{arb} = \frac{\text{number of convertibles issued} \times \text{face value} \times \text{delta}}{\text{conversion price}} \quad (1)$$

We calculate the number of convertibles issued by dividing the offering proceeds by the face value of the convertible (both obtained from SDC). Delta represents the sensitivity of the convertible bond value to its underlying common stock value. In line with Burlacu (2000), Dutordoir and Van de Gucht (2007), and Loncarski et al. (2009), we calculate the convertible debt delta as follows:

$$\text{Delta} = e^{-\delta T} N(d_1) = e^{-\delta T} N\left\{ \frac{\ln(\frac{S}{X}) + (r - \delta + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} \right\}, \quad (2)$$

with δ the continuously-compounded dividend yield (obtained from Compustat Fundamentals Annual by dividing #26 by #199), N(.) the cumulative probability under a standard normal distribution, S the stock price on trading day −5 (obtained from CRSP), X the conversion price (obtained from SDC), r the yield on a ten-year U.S. Treasury Bond measured on the issue date (obtained from CRSP), σ the annualized stock return volatility (measured as outlined in Appendix A), and T the stated maturity of the convertible bond measured on its issuance date (obtained from SDC).[21]

[21] As argued in Zabolotnyuk, Jones, and Veld (2010), a potential disadvantage of the delta is that it does not capture convertibility and callability characteristics. As such, the delta provides an incomplete measure for the equity component size of convertibles. However, the purpose of the delta measure included in the S_{arb}

Appendix C: Calculation of convertible debt offering discounts

In line with Chan and Chen (2007) and De Jong, Dutordoir, and Verwijmeren (2010), we define the convertible debt offering discount as the difference between the bond's theoretical price and the bond's issue price, divided by the bond's theoretical price. We obtain the issue price from SDC. To calculate the theoretical convertible bond price, we use the Tsiveriotis and Fernandes (1998) model, which is widely-used in other studies on convertible bond underpricing (Ammann, Kind, and Wilde, 2003; Chan and Chen, 2007; Loncarski et al., 2009; De Jong, Dutordoir, and Verwijmeren, 2010). As pointed out by Zabolotnyuk et al. (2010), the method is also popular among practitioners.

Tsiveriotis and Fernandes (1998) use a binomial-tree approach to model the stock price process and decompose the total value of a convertible bond into an equity component and a straight debt component. We use the following input variables in the model (all measured as of the convertible bond issue date, unless otherwise mentioned): yield on U.S. government bonds of which the maturity most closely matches the maturity of the convertible bond (obtained from CRSP); Moody's credit ratings or equivalent Standard and Poor's ratings converted to a Moody's rating (obtained from SDC);[22] credit spreads of similarly-rated corporate straight debt (obtained from Datastream);[23]

variable is to replicate the inputs that are actually used by arbitrageurs in their delta-neutral hedging strategy. Calamos (2003) argues that arbitrageurs base their hedging on a delta measure analogous to the one defined in Equation (2), so we conclude that it is appropriate to use this measure as an input in S_{arb}.

[22] We assign a rating of Baa2 to unrated convertibles, as in Loncarski et al. (2009).

[23] Datastream discontinues the provision of credit spreads as of the end of 2008, so we construct our own credit spread estimates for convertibles issued in 2009. In 2009, 95% of our sample offerings are unrated (and thus classified as Baa2-rated offerings), while the remainder of the offerings are speculative grade. To calculate Baa2 credit spreads, we subtract the 20-year Treasury Bond rate (obtained from CRSP) from the yield on Baa-rated bonds (obtained from Bloomberg). To measure the credit spread for the (very few) speculative grade issues, we download the Barclays yield series on high-yield U.S. corporate bonds from Datastream and subtract the 20-year Treasury Bond rate from this yield. We tried using other benchmark maturities (7-, 10-, and 30-year Treasury Bond yields), but the 20-year yield results in spreads with the highest correlation and the smallest difference with the credit spreads reported by Moody's.

conversion ratios and call schedules; dividend yield for the fiscal year preceding the announcement date, price of the underlying stock averaged between trading days –12 and –2; and annualized stock return volatility calculated from daily stock returns over the window (–240, –40).