WHY ARE CONVERTIBLE BOND ANNOUNCEMENTS ASSOCIATED WITH INCREASINGLY NEGATIVE ISSUER 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 associated with a range of hedging strategies. Post-issuance stock returns are also in line with the arbitrage explanation. Average announcement effects of convertibles issued during the Global Financial Crisis are even more negative (-9.12%), due to a combination of short-selling price pressure and issuer, issue, and macroeconomic characteristics associated with these offerings.

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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]

This paper is inspired by the observation that stock returns around convertible bond announcements have sharply declined over the past decade, whereas there is no corresponding decline in seasoned 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%).

We hypothesize that the sharp decline in observed convertible bond announcement effects 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 equity (Lummer and Riepe, 1993). However, Choi et al. (2009) show a dramatic increase in the importance of convertible arbitrage funds since the end of the 1990s. To exploit underpriced convertible issues, convertible arbitrageurs buy convertible debt 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 around the convertible bond issue date. Most recent convertibles are placed very quickly,

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

resulting in a very short time span (one trading day or less) between announcement and issuance. Our key prediction is therefore that the observed highly negative "announcement" effects of recent convertible bond issues may partly reflect temporary price pressure associated with arbitrage-induced short selling upon convertible bond issuance.

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 et al., 2011), 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 issuer-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 arbitrageurs, as opposed to short selling by fundamental traders.

In line with our hypothesis, we find that the difference in announcement-period stock 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 assuming different convertible arbitrage strategies (delta-neutral, bullish gamma, and bearish gamma hedging). Our analysis controls for a wide range of issuer-specific, issue-specific, and macroeconomic determinants of convertible bond announcement effects.

The Global Financial Crisis sparked a sharp contraction in the convertible arbitrage hedge fund industry. 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."* To the extent that this shift in the investor base results in less short selling, we expect to observe less negative abnormal announcement returns for convertibles issued during the Crisis. However, our event study results indicate that average stock returns around the announcements of convertible bonds issued between the Lehman Brothers collapse in September 2008 and December 2009 are almost twice as negative as in the Arbitrage period (-9.12%). Our evidence suggests that the highly negative announcement effects of Post-Lehman convertibles can be attributed to short-selling price pressure from the remaining convertible arbitrage funds in the market, as well as to offering and market characteristics that negatively affect announcement returns (high issuer and market volatility, and severe offering underpricing).

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. Since arbitrage-induced short selling does not result from fundamental news about the stock, we expect a reversal of the negative stock price impact of arbitrage-related short selling once the market has absorbed the additional supply of shares. 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 arbitrage demand associated with these offerings. In contrast, we find no evidence of such reversal for issues made during periods with lower arbitrage fund involvement in convertible bond issues.

Our analysis contributes to the following three stands of literature. First, we complement event studies on stock returns around convertible debt announcements. A common finding of these studies is that convertibles induce negative abnormal stock returns intermediate in size between the announcement effects associated with seasoned equity and straight debt offerings

(Dann and Mikkelson, 1984; Mikkelson and Partch, 1986; Lewis et al., 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. Our study sheds new light on these stylized facts by documenting that announcement-period stock returns associated with post-2000 convertible offerings are far more negative than those for equity offerings made over the same period. However, we also show that part of the highly negative "announcement" return associated with recent convertible bond offerings is actually caused by 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 overly pessimistic conclusions on the true magnitude of the transactions' impact on firm value.

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 arbitrageurs on convertible issuance volumes (Choi et al., 2010; De Jong et al., 2010) and convertible bond design (Brown et al., 2010; De Jong et al., 2011). Our study complements these papers by examining the impact of buy-side shifts on the stock returns around convertible bond announcements.

Third, our paper complements a number of studies on the performance of convertible arbitrage strategies (Fabozzi et al., 2009; Agarwal et al., 2010; Hutchinson and Gallagher, 2010). While these articles focus on portfolio returns realized by convertible arbitrage funds over the years following issuance, our key goal is to analyze to what extent the short-selling transactions of convertible arbitrageurs affect issuer stock returns around convertible bond issuance. We find that post-issuance changes in required short-selling positions are very small and therefore unlikely to provoke strong issuer stock price reactions beyond the issue date, even with daily rebalancing of arbitrage portfolios.

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

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 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 stock returns around convertible debt announcements commonly find that these returns are negative and intermediate in size between the announcement effects associated with seasoned equity and straight debt offerings.[2] The majority of these studies focus on a period in which convertible bond investors (such as mutual funds specialized in convertible bond investments) buy the convertibles without shorting the underlying stock. However, around the year 2000 the convertible bond investor base shifted from traditional long-only buyers towards

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[2] See Eckbo et al. (2007) for an overview of event studies on security offering announcement returns.

convertible arbitrageurs (mostly hedge funds, but also institutional investors). By the beginning of the 21st century, hedge funds were purchasing up to 80% of new convertible issues (Brown et al., 2010). The recent Global Financial Crisis, in turn, marked a substantial decline in the importance of convertible arbitrageurs driven by negative performance, heavy redemptions, and severe reductions in inflows (Credit Suisse/Tremont Hedge Index research report, 2009; Hutchinson and Gallagher, 2010; Steinbrugge, 2011).

The main goal of this paper is to examine the impact of these two important shifts in the involvement of convertible arbitrage funds on issuer stock returns around convertible bond offerings. We distinguish three periods, each with a different involvement of convertible arbitrageurs. It is difficult to pinpoint the exact moment when convertible 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.[3] 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 hedge funds at the end of the 1990s.[4] 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 arbitrageurs, and label the previous window (from 1984 to December 1999) the Traditional Investor period.

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

[4] 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.*"

As argued by Beber and Pagano (2012), the Lehman Brothers collapse 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 period, labeled the "Post-Lehman" period.

[Please insert Figure 1 here]

2.2. Testable predictions

Unlike traditional long-only investors, convertible arbitrageurs generally short a portion of the convertible debt issuer's stock 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 from their ability to exploit superior technology in managing convertible risk. Potential reasons for convertible debt underpricing include illiquidity, small issue size, and complexities associated with the valuation of hybrid securities (Lhabitant, 2002).

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 pressure around the convertible bond issue date. A number of studies effectively find evidence of negative abnormal stock returns around convertible bond issue dates (Arshanapalli et al., 2005; Loncarski et al., 2009; De Jong et al., 2011).

Arguably, arbitrageurs should establish their short positions on convertible bond issue dates rather than on announcement dates. However, almost all recent convertible bond offerings take place within one trading day of the announcement date. The most important reason for this rapid placement is that most recent convertibles are structured as Rule 144A offerings. Such offerings can be sold to selected institutional investors without having to incur time-consuming activities

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such as road shows and Securities and Exchange Commission (SEC) filings. As a result of the overlap between issuance and announcement dates, the observed "announcement" effect of convertible bond issues may reflect price pressure associated with the shorting activities of convertible arbitrageurs. Given the different levels of involvement of this investor class over the three periods considered in our study, we 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 issuer characteristics, issue characteristics, and macroeconomic conditions (Lewis et al., 1999, 2003; Dutordoir and Van de Gucht, 2007; Krishnaswami and Yaman, 2008; Loncarski et al., 2008). Any observed difference in the stockholder wealth effects of convertible bond offerings across the three periods may thus be caused by intertemporal changes in these determinants. We establish whether the differences in convertible debt announcement returns across the three periods are effectively caused by shifts in buy-side characteristics by testing the following prediction:

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

If demand curves are only inelastic in the short run, stock prices should revert to their fundamental values once the market has absorbed the supply shock caused by arbitrage-related short selling. Given that convertibles issued in the Arbitrage period are likely to provoke more arbitrage-induced price pressure, we expect to observe stronger positive stock price reversals for these issues compared with offerings made during the Traditional Investor or Post-Lehman periods. We thus obtain the following hypothesis:

Hypothesis 3: Arbitrage-period convertible offerings are followed by a stronger positive stock price reversal than Traditional Investor- and Post-Lehman-period convertibles.

3. Data and methodology

3.1. Convertible bond, seasoned equity, and straight debt samples

We obtain data for U.S. convertible debt, seasoned equity, and straight debt offerings made 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 debt 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 thus obtain a data set of 1,436 convertible debt issues, 4,885 seasoned equity issues, and 8,734 straight debt issues. The Traditional Investor period accounts for 727 issues, the Arbitrage period for 645 issues, and the Post-Lehman period for 64 issues.

We obtain balance sheet and income statement variables from the Compustat Fundamentals Annual database, stock price-related data (i.e., prices, shares outstanding, and trading volumes) from the Center for Research in Security Prices (CRSP), issue-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 debt 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 (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 relative to the announcement date. 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 et al. (2011).

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 isolate the portion of the ΔSI/SO measure that can effectively be attributed to short selling by convertible arbitrageurs by regressing ΔSI/SO on potential determinants of convertible arbitrageurs' interest in that particular convertible offering. We take the predicted value of this regression for each convertible bond issue as a measure for the change in short interest caused by arbitrage-related short selling for that convertible bond.[5]

We expect convertible arbitrageurs to be more interested in issuers with more liquid shares (since high liquidity makes it easier for them to obtain their hedging positions), with no dividend payouts (since dividends represent a cash outflow for short sellers), with higher institutional ownership (since institutional investors are more likely to lend out their shares than individual investors), and with more volatile stock returns (since volatility positively affects the option

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[5] 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.

value of the convertible, thus allowing a higher potential profit). We therefore consider the Amihud (2002) measure for illiquidity, a dummy variable equal to one for convertible debt issuers that paid out a dividend in the previous fiscal year, the percentage of institutional ownership (obtained from Thomson Reuters), and the issuer's stock return volatility as potential issuer-specific determinants of the arbitrage demand for convertible debt offerings. Appendix A contains detailed definitions of all explanatory variables included in this paper.

In addition, we 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 therefore include the ratio of DeltaNeutral to shares outstanding (SO), with DeltaNeutral representing the expected number of shares shorted by arbitrageurs following a delta-neutral hedging strategy. Appendix B provides a detailed definition of this variable. Although delta-neutral hedging represents the "bread-and-butter" strategy of convertible arbitrageurs (Calamos, 2003), arbitrage funds may also follow directional hedging strategies in which they short sell slightly more or less than what would be required under a delta-neutral hedge (Calamos, 2003; Fabozzi et al., 2009).[6] Consistent with Fabozzi et al. (2009), we define GammaBear (GammaBull) as the number of shares expected to be shorted under a bearish (bullish) gamma hedging strategy in which arbitrageurs short sell delta plus (minus) 0.09 at issuance. The bearish gamma hedge yields a small profit when stock prices decrease, and the bullish gamma hedge yields a small profit when stock prices increase. Appendix B provides detailed definitions for these variables. We also expect arbitrageurs' interest to be positively

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[6] Fabozzi et al. (2009) also consider a range of other strategies followed by arbitrage funds. For example, funds can engage in convergence hedge strategies in which they exploit pricing differentials between options and convertibles with the same underlying stock, or between different convertible bonds. For the purpose of our analysis, only hedging strategies involving short selling of the issuer's stock are relevant.

influenced by the convertible debt gamma, calculated as outlined in Appendix B. Gamma captures the sensitivity of the convertible's delta with respect to changes in the underlying stock price. A convertible with a high gamma offers dynamic hedging opportunities more frequently, thus allowing the possibility of higher returns (Calamos, 2003). Finally, we 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]

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

We find evidence of significant differences in arbitrage 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 periods (from 41% to 72%), and stock return volatility is almost twice as large for Post-Lehman issuers than

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for other issuers. Convertible bond gammas increase significantly over the sample period, from an average of 0.005 in the Traditional Investor period to an average of 0.014 in the Post-Lehman period.[7] 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 arbitrage-related short selling. 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 including issuer- and issue-specific features, the reported regressions also control for temporal variations in the capital supply from convertible arbitrageurs. As a first proxy for fluctuations in the importance of convertible arbitrageurs as an investor class, we count 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 distinguish between positive and negative developments affecting the capital supply of convertible arbitrageurs (i.e., it abstracts from the specific content of the news sources). We therefore consider lagged capital flows into convertible arbitrage funds (CAFlows) over the quarter prior to issuance as an alternative proxy for temporal fluctuations in the importance of hedge funds as an investor class. 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.

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[7] The gammas of the convertibles in our data set are low. This finding can be attributed to the fact that we measure gamma on the convertible debt issue date, when most convertibles are still relatively far out of the money. Gamma tends to be highest for at the money convertibles (Calamos, 2003).

The R^2s of the regression specifications indicate that 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.

In Columns (1) and (2), we assume that the arbitrageurs follow a delta-neutral hedging strategy. Column (1) includes CAFactiva and Column (2) includes CAFlows, which is only available for 330 observations. In line with our predictions, we find a significant negative impact of the Amihud illiquidity measure (both columns), and a significant positive impact of the percentage of institutional ownership (Column (1)) and of the required amount of shares to be shorted, measured as DeltaNeutral/SO (both columns), on ΔSI/SO. None of the other variables has a significant impact. In Column (3), we replicate the analysis in Column (1) assuming that arbitrageurs adopt a bearish gamma hedging strategy. We find that GammaBear/SO has a highly significant positive impact with a coefficient size similar to that of DeltaNeutral/SO, with the other regression results remaining largely unaltered. As can be seen from Column (4), a similar conclusion holds when we assume that arbitrageurs follow a bullish gamma hedging strategy. Our results thus seem very robust to alternative hedging strategies. This conclusion is not surprising, as the gamma hedging strategies involve only mild deviations from delta-neutral hedging, resulting in very high pairwise correlations (over 0.90) between the DeltaNeutral, GammaBear and GammaBull measures.[8]

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

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[8] As argued by Calamos (2003), hedge fund consultants generally consider anything more than a very mild deviation from the delta required for delta-neutral hedging inappropriate for a convertible arbitrage portfolio.

explanatory variables available, we multiply the value of the regression coefficients by the values of the correspondent explanatory variables. The resulting value, labeled ArbDemand/SO, represents the estimated change in short interest relative to shares outstanding caused by convertible arbitrageurs' short selling associated with that particular convertible bond.[9]

3.3. Control variables

Next to our hedging demand measure, we include a number of issuer-specific variables in our analysis of convertible bond announcement stock returns. Appendix A provides a detailed definition of each of the control variables. All issuer characteristics included in the regression analyses are measured at the 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 stock returns to be more negative for issuers with high costs of attracting new debt financing.[10] In line with Lewis et al. (1999, 2003), we use the amount of slack capital and the pre-announcement stock runup as proxies for equity-related financing costs. When a firm with sufficient slack capital or a high stock runup issues equity, stockholders are more likely to infer that this firm is overvalued. We thus expect both the slack

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[9] 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.

[10] 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.

capital and the pre-announcement stock runup to have a negative impact on stockholder reactions to convertible debt announcements. To capture debt-related financing costs, 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 credit rating of the offering (transformed into a numerical measure as outlined in Appendix A). Higher CreditRating values imply worse credit ratings, and therefore a higher credit risk associated with the offering. We also 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 stock returns. Following Myers and Majluf (1984), we expect relatively more equity-like convertibles to induce more negative stockholder wealth effects. To capture the convertible bond's equity component size, we include the conversion premium and the

convertible bond maturity. Bonds with a larger (smaller) conversion premium (maturity) are assumed to be less equity-like. We obtain similar results when we replace the conversion premium and the maturity by the convertible debt delta, which acts as an umbrella measure of the convertible bond equity component size.[11] We also include a 144A dummy variable to disentangle the effect of the Rule 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 coincides with the announcement date or falls on the trading day after the announcement date. Convertibles for which this is the case are expected to be associated with more negative announcement returns, since their announcement-period stock returns are more likely to capture hedging-induced price pressure. We also control for convertible bond underpricing at issuance (calculated as outlined in Appendix C). Offerings with higher initial underpricing should be received less favorably by the market, since they imply a wealth transfer from existing stockholders to convertible bondholders.

Finally, we include a number of standard macroeconomic variables suggested by the literature, i.e., interest rates, term spreads, market runups, 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 economy-wide financing costs. We thus predict 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 et al., 1993; Korajczyk and Levy, 2003; Krishnaswami and Yaman, 2008). In turn, we expect a positive impact of market returns, since financing costs are assumed to be lower

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[11] Detailed results of all untabulated robustness checks mentioned in the paper are available on demand.

during market booms (Choe et al., 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 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 lower tax levels and higher debt levels, suggesting higher debt-related financing costs; on the other hand they tend to have a larger firm size, suggesting lower costs of attracting external financing. They also have lower market-to-book ratios than issuers in preceding periods.

We also uncover significant differences in almost all issue-specific characteristics across the three windows. Convertible bond offerings have significantly better credit ratings towards the end of the research period, as reflected in smaller CreditRating values. Consistent with Fabozzi et al. (2009), we find an increase in conversion premia after the year 2000, but conversion premia decrease again during the Post-Lehman period. In line with Huang and Ramirez (2010), we find that the percentage of convertibles issued under Rule 144A increases dramatically as of the year 2000. 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, from the Arbitrage period onwards. This finding can be attributed to the rapid placement of recent convertibles, which is in turn caused by the increase in the importance of Rule 144A offerings and by the very fast buying decisions of convertible arbitrage funds (Dong et al., 2012). During the Traditional Investor period, underpricing is significantly higher than during the Arbitrage period. However, Arbitrage-period convertibles are still substantially underpriced, thus offering ample profit potential for convertible arbitrageurs. Post-Lehman offerings, in turn, are offered at discounts that are more than twice as large as underpricing levels during the Arbitrage period. One possible explanation for this finding is that, during the Global Financial Crisis, issuers that are unable to obtain standard financing sources use convertible bonds as a last-resort financing type. These high underpricing levels may be necessary to convince risk-averse investors to include the convertibles in their portfolios.

Finally, most of the macroeconomic variables are also significantly different across the three periods. For example, we find that market volatility is significantly higher during the Post-Lehman period than in preceding 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. Impact of arbitrage short selling on convertible debt announcement returns

4.1. Convertible debt, seasoned equity, and straight debt announcement returns

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-period stock 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.[12] 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 in Factiva. For seasoned 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 Rule 144A offerings or privately placed (60% 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, security offering announcement effects are similar in magnitude to those documented in prior studies (see, e.g., Eckbo et al., 2007). This is no surprise

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[12] We manually cross-check 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.

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 stock 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 stock returns remain fairly stable. 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 stock 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 (the 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 announcement-period stock 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 to 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-period stock returns exhibit a declining trend. Returns drop sharply 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]

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4.2. Determinants of convertible debt announcement returns

In the next step of the empirical analysis, we test whether the evolutions in convertible debt announcement returns documented in Table 3 and Figure 2 can 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 the dependent variable.

[Please insert Table 4 here]

Column (1) includes a dummy variable equal to one for convertibles issued during the Arbitrage period, and a dummy variable equal to one for convertibles issued during the Post-Lehman period. Both variables have significantly negative regression coefficients. In line with the univariate test results, we find that the differences between the periods are large in economic terms. The abnormal return in the Arbitrage Period is 283 basis points lower than in the Traditional Investor period, and the abnormal return in the Post-Lehman period is 716 basis points lower than in the Traditional Investor period.

In Column (2), we extend the regression with the control variables specified earlier. The inclusion of these variables results in a substantial increase in the adjusted R^2, from 7.40% to 10.35%. As expected, CARs are negatively influenced by long-term debt and issuer stock return volatility.[13] CARs are significantly positively influenced by the market-to-book ratio, which is consistent with results reported by De Jong et al. (2011). In line with our predictions, we also find that abnormal returns are significantly negatively influenced by the

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[13] Our finding on issuer stock return volatility is consistent with Liu and Switzer (2009), who find a negative impact of firm risk measures on stock price reactions to convertible debt announcements.

Issuance=Announcement dummy variable, term spreads, and market return volatility. The only finding that is inconsistent with our predictions is the significant positive impact of interest rates.

Most importantly, the coefficients of the ArbPeriod and PostLehmanPeriod dummy variables remain significantly negative when controlling for issue, issuer, and macroeconomic characteristics. However, the magnitude of the coefficients for both periods drops to approximately 60% of their size in Column (1). Thus, part of the more negative announcement returns for convertibles issued during the Arbitrage and Post-Lehman periods seems to be caused by the fact that these offerings have higher values (compared with Traditional Investor-period offerings) on characteristics that negatively affect convertible bond announcement returns. For example, as documented in Table 2, the Post-Lehman period is characterized by high issuer volatility, a high percentage of offerings with overlapping issue and announcement dates, and high market volatility. All of these characteristics turn out to have a significant negative impact on convertible bond announcement returns in Column (2) of Table 4.

Hypothesis 2 predicts that the differences in convertible bond announcement returns between the three periods should no longer be significant after controlling for differences in arbitrage-related short selling. In Column (3), we test this prediction by including the variable ArbDemand/SO, which captures the predicted hedging demand from convertible arbitrageurs. We interact this variable with each of the three period dummy variables. The interaction term of ArbDemand/SO with the ArbPeriod dummy variable has a strongly significant negative impact on convertible debt announcement returns, which corroborates the importance of arbitrage-induced short selling during the Arbitrage period. The interaction terms of ArbDemand/SO with the two other period dummy variables also have a significant negative impact, but with much smaller coefficient sizes than for the ArbDemand/SO*ArbPeriod interaction term. This pattern is

consistent with the notion that convertible arbitrageurs are also active during the Traditional Investor and Post-Lehman periods, albeit to a lesser extent than during the Arbitrage period.[14] Consistent with Hypothesis 2, the coefficient on the ArbPeriod dummy variable is no longer significantly negative after controlling for arbitrage-induced short selling. In fact, the dummy's coefficient is now positive, albeit not statistically significant. We also find that the PostLehmanPeriod dummy variable is no longer significant after controlling for arbitrage-induced short selling. Our results thus suggest that arbitrage-induced short selling during the Global Financial Crisis was still substantial enough to explain the announcement return differences between Traditional Investor- and Post-Lehman-period convertibles. Apparently, the convertible issues made during the Crisis attracted considerable interest from the remaining hedge funds in the market.[15] Slack capital now has a significant negative impact, while it was previously not significant, and long-term debt, market-to-book, and the Issue=Announcement dummy are no longer significant. The findings with respect to the other control variables remain largely unaffected by the inclusion of the ArbDemand/SO interaction terms.

The remaining regression specifications in Table 4 serve to test the robustness of the results in Column (3). Column (4) includes convertible debt underpricing as an additional control variable. Due to the limited availability of some of the input variables needed to calculate underpricing, we can only estimate this regression from 1991 onwards. As expected, we find a significant negative impact of underpricing on announcement returns. Thus, the extremely high underpricing levels of Post-Lehman convertible offerings may also contribute to their highly

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[14] Calamos (2003) notes that convertible arbitrage has been used since the 19th century.

[15] It is important to note that none of the Post-Lehman offerings in our sample were issued during the SEC's short-sale ban. This ban ranged from September 19, 2008 until October 9, 2008 and mainly affected financial stocks (see Grundy et al., 2012).

negative announcement returns.[16] The other regression results are largely similar to those in Column (3).

Column (5) includes interaction terms based on DeltaNeutral/SO as a measure of arbitrage-induced short selling for a given convertible. Using DeltaNeutral instead of ArbDemand provides a more direct measure of the impact of the amount of shares sold short on convertible bond announcement returns. Consistent with the findings in Column (3), we find that the interaction term between DeltaNeutral/SO and the ArbPeriod dummy variable has a highly significant negative impact. Also similar to Column (3), the ArbPeriod dummy variable is not significant when controlling for this interaction term. The coefficient of the interaction term indicates that a one percentage point increase in the amount of shares sold short relative to shares outstanding leads to a 0.278 percentage points decrease in convertible bond announcement returns. However, in contrast with the findings in Column (3), the interaction term of DeltaNeutral/SO with the PostLehmanPeriod dummy does not have a significant coefficient, and the PostLehmanPeriod dummy variable coefficient remains significantly negative when controlling for arbitrage-induced short selling. One explanation for this divergence in the results is that DeltaNeutral does not take into account other issue and issuer characteristics significantly affecting hedging demand (i.e., illiquidity and the percentage of institutional ownership), and may as such be a less accurate measure for arbitrage interest in a given offering than ArbDemand.

Columns (6) and (7) replicate Column (3) assuming that arbitrageurs follow, respectively, a bearish gamma and a bullish gamma hedging strategy instead of a delta-neutral hedging strategy.

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[16] Inconsistent with this interpretation, the coefficient on the PostLehmanPeriod dummy variable in Column (4) (in which we control for underpricing) is not much different from that in Column (3) (in which we do not control for underpricing). However, it is important to note that the regression in Column (4) is only estimated for a subset of the data set (issues made from 1991 onwards), so that the coefficients are not directly comparable.

This analysis involves recalculating ArbDemand using the coefficients from Columns (3) and (4) of Panel B, Table 1, respectively. The findings are virtually similar to those in Column (3).

Fabozzi et al. (2009) find that the strong increase in conversion premia as of the year 2000 acts as a substantial driver of hedge fund returns. To examine whether changes in conversion premia over the three periods affect our findings, Column (8) includes interaction terms of the conversion premium with the ArbPeriod and PostLehmanPeriod dummy variables. We find that these interaction terms are not significant. Their inclusion leaves our other findings virtually unaltered. Overall, the findings in Table 4 provide strong evidence for Hypothesis 2.

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 issue 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 5 reports the results of this analysis.

[Please insert Table 5 here]

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

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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 et al., 2011), 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 signalling content of the convertibles and the effect of price pressure resulting from arbitrage trading.

By contrast, we find no evidence of a positive stock price reversal in the Traditional Investor and Post-Lehman periods. In fact, abnormal stock returns over the window (2, 10) are significantly negative during both periods. The finding of negative post-issuance returns is consistent with Lewis et al. (2001), who report long-run stock price underperformance following convertible debt issuance over longer investment horizons.

In Panel B, we regress post-issuance stock returns on our measure for arbitrage-related increases in short interest. This regression analysis helps us verify whether the positive stock price reversal recorded for Arbitrage-period convertibles can effectively be attributed to the market absorption of arbitrage-induced short sales. If this is the case, then we should observe a larger stock price reversal for Arbitrage-period convertibles with higher hedging demand by convertible arbitrageurs, as captured by the ArbDemand/SO measure. Next to the interaction terms of the ArbDemand variable with the three period dummies, the regression also includes an Amihud illiquidity measure, since price reversals are expected to be stronger for more illiquid stocks (Bagwell, 1992).

Consistent with the arbitrage explanation for post-issuance reversals in the Arbitrage-period announcement returns, we find a significant positive impact of the ArbDemand/SO*ArbPeriod

interaction term over both windows. By contrast, we find no significant impact of the corresponding interaction terms during the Traditional Investor and Post-Lehman periods. Consistent with Hypothesis 3, we thus obtain stronger evidence of positive stock price reversals during years with higher involvement of convertible arbitrage funds. Our findings are robust to calculating ArbPeriod assuming a bearish gamma or bullish gamma instead of a delta-neutral hedging strategy.

When stock prices increase, convertible bond deltas increase, resulting in larger required short positions (and vice versa for stock price decreases). To verify the potential impact of convertible arbitrageurs' portfolio rebalancing actions on our results, Panel C of Table 5 presents average changes in convertible debt deltas and associated changes in required short positions (as captured by DeltaNeutral) over trading days one to ten following issuance. Column (1) reports the increase in delta relative to the previous trading day. At the start of day +1 following issuance, average deltas have slightly decreased relative to issue-date deltas due to issue-date stock price decreases. Overall, the daily changes in delta are very small. Since large delta increases for some firms could be masked by large delta decreases for other firms, Column (2) provides the average absolute changes in delta. We find that these changes are also minor.

Columns (3) to (5) provide more insight into the required changes in shares shorted to preserve a delta-neutral hedging position, assuming daily rebalancing of the portfolio. Given the small changes in delta, it is not surprising that post-issuance changes in the number of shares to be shorted are marginal. The short positions need to be reduced by only 10,642 shares at the start of trading day +1 following issuance, corresponding with a mere 0.07% of the average DeltaNeutral position on the issue date. The required changes in shares shorted over subsequent trading days are even smaller. Column (4) shows that the average cumulative increase in

required short selling, as a percentage of the issue-date DeltaNeutral position, is only 0.16%. Column (5) indicates that considering absolute changes in required short selling leads to similar conclusions. Overall, Panel C shows that post-issuance changes in deltas and required delta-neutral shorting positions are very small compared with the initial establishment of the short position on the issue date.[17] Under typical rebalancing thresholds, such as the ones suggested by Fabozzi et al. (2009), (i.e., delta change tolerances between 0.02 and 0.3), we would observe even smaller changes in short positions.

5. Conclusion

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. In the Traditional Investor period, which ranges from 1984 to 1999 and is dominated by long-only investors, average convertible debt announcement effects are -1.69%. In the Arbitrage period, which ranges from 2000 to September 2008 and is dominated by convertible arbitrage hedge funds, average convertible debt announcement effects drop to -4.59%. We hypothesize that this sharp decrease can be attributed to price pressure resulting from the hedging transactions of convertible arbitrageurs. Consistent with this hypothesis, we find that the differences between Traditional Investor- and Arbitrage-period announcement returns are no longer significant after controlling for arbitrage-induced short selling. This result is robust to assuming a range of arbitrage strategies and arbitrage-induced short selling measures.

For convertibles issued after the Lehman Brothers collapse in September 2008, we find even more negative average announcement effects of -9.12%. Our evidence indicates that these highly

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[17] Our findings remain similar when considering only Arbitrage-period issues (untabulated).

negative stock price reactions can partly be explained by arbitrage-induced price pressure. Although the Global Financial Crisis sparked a decrease in hedge fund capital available for convertible debt investment, our findings suggest that the convertibles issued during the Crisis are still heavily taken up by the remaining convertible arbitrage funds. Moreover, Post-Lehman offerings have certain characteristics (e.g., high issuer and market volatility, and very high offering underpricing) that further depress convertible bond announcement returns.

An interesting question is why firms have continued to issue convertible securities during periods dominated by convertible arbitrage funds as investors, given the negative impact of these arbitrageurs' short-selling actions on issuer stock prices. Our analysis of post-issuance abnormal stock returns suggests that the prospect of incurring announcement-period price pressure may not be an important deterrent of convertible bond issuance, since part of the price pressure is reversed quickly after issuance. Moreover, as shown by Brown et al. (2010), hedge funds can act as relatively low-cost distributors of equity exposure for firms with high costs of raising seasoned equity. Firms may trade-off these lower issuance costs with the prospect of arbitrage-induced price pressure when deciding between financing types.

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Table 1: Determinants of changes in short interest around convertible bond issuance

Panel A shows summary statistics for the potential determinants of 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. 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. We use a Kruskal-Wallis test to jointly examine the differences in each issuer- and issue-specific characteristic between all three sub-periods. In the last column, the letter "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. We use an independent sample t-test (assuming unequal variances) to examine the equality of means across any two sub-periods for continuous variables, and a χ^2-test to examine the equality of proportions across any two sub-periods for dummy variables (i.e., DividendPaying and ZeroCoupon). Panel B presents the results of an OLS regression analysis 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	Significance of 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
DividendPaying	37.451%			20.411%			25.609%				a
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
DeltaNeutral/SO	0.160	0.129	0.130	0.105	0.092	0.069	0.133	0.116	0.083	0.000	a,b,c
GammaBear/SO	0.177	0.143	0.142	0.117	0.104	0.069	0.148	0.131	0.091	0.000	a,b,c
GammaBull/SO	0.142	0.115	0.117	0.093	0.082	0.062	0.118	0.101	0.076	0.000	a,b,c
Gamma	0.005	0.003	0.006	0.009	0.005	0.011	0.014	0.008	0.016	0.000	a,b,c
ZeroCoupon	7.290%			7.878%			0.000%				b,c

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

Variable	Parameter estimate			
	(*t*-value)			
	(1)	(2)	(3)	(4)
Amihud	-0.012**	-0.020*	-0.012**	-0.020**
	(-2.03)	(-1.89)	(-2.03)	(-2.04)
DividendPaying	0.004	0.003	0.004	0.003
	(1.30)	(0.94)	(1.44)	(1.19)
InstitOwnership	0.009*	0.001	0.009*	0.008
	(1.66)	(0.21)	(1.69)	(1.64)
Volatility	-0.007	0.002	-0.007	-0.006
	(-1.26)	(0.39)	(-1.30)	(-1.23)
DeltaNeutral/SO	0.143***	0.138***		
	(8.54)	(7.50)		
GammaBear/SO			0.159***	
			(8.42)	
GammaBull/SO				0.131***
				(8.63)
Gamma	0.127	0.050	0.137	0.118
	(1.33)	(0.47)	(1.44)	(1.24)
ZeroCoupon	-0.000	0.001	-0.000	-0.000
	(-0.06)	(0.10)	(-0.07)	(-0.05)
CAFactiva	-0.000		-0.000	-0.000
	(-1.39)		(-1.39)	(-1.39)
CAFlows		0.005		
		(0.35)		
Intercept	0.003	0.000	0.003	0.002
	(0.36)	(0.04)	(0.38)	(0.35)
Adj. R^2	19.82%	18.98%	19.46%	20.08%
R^2	21.31%	20.96%	20.95%	21.56%
N	440	330	440	440
Period	2003-2008	2003-2008	2003-2008	2003-2008

Table 2: Summary statistics for potential determinants of stock returns around convertible bond announcements

This table provides descriptive statistics for issuer-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. 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. We use a Kruskal-Wallis test to jointly examine the differences in each issuer- and issue-specific characteristic between all three sub-periods. In the last column, the letter "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. We use an independent sample t-test (assuming unequal variances) to examine the equality of means across any two sub-periods for continuous variables, and a χ^2-test to examine the equality of proportions across any two sub-periods for dummy variables (i.e., 144A and Issue=Announcement). 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.		
Issuer-specific											
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-specific											
CreditRating	11.874	13.000	2.856	10.117	9.000	2.387	9.400	9.000	1.330	0.000	a,b,c
Proceeds	0.400	0.289	0.424	0.359	0.224	0.462	0.129	0.078	0.132	0.000	b,c
ConvPremium	22.185	22.000	7.478	32.721	30.010	13.903	22.709	25.000	8.330	0.000	a,c
Maturity	16.704	15.240	7.444	14.877	20.095	8.942	6.945	5.033	5.426	0.000	a,b,c
144A	9.491%			84.651%			34.375%				a,b,c
Issue=Announcement	25.722%			88.372%			95.313%				a,b
Underpricing	0.215	0.219	0.090	0.157	0.150	0.131	0.342	0.340	0.102	0.000	a,b,c
Macroeconomic											
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 stock returns around convertible debt, equity, and straight debt announcements
This table shows average 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, as well as the standard deviation (std.dev) of these returns. 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. We use a Patell Z-test to examine whether individual CARs are equal to zero. [*], [**], [***] indicate significance of the Patell Z-test statistic at the 10%, 5%, and 1% level, respectively. We use a Kruskal-Wallis test to jointly examine differences between the CARs across all three sub-periods. 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)	-1.691%[***]	5.074%	-4.587%[***]	7.200%	-9.116%[***]	9.405%	0.000
N	727		645		64		
CARsEQ(-1, 1)	-2.343%[***]	6.125%	-2.665%[***]	7.676%	-3.218%[***]	11.668%	0.272
N	3,579		1,143		163		
CARsSD(-1, 1)	-0.094%[*]	3.668%	-0.037%	3.993%	-0.404%[**]	5.939%	0.061
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 of convertible offerings on a number of potential determinants. The dependent variable is the cumulative abnormal stock return measured over the window (-1, 1) relative to the announcement date, calculated using standard event study methodology. TradInvestorPeriod is a dummy variable equal to one for convertible bond offerings announced in the Traditional Investor period, which ranges from 1/1/1984 to 31/12/1999, and equal to zero otherwise. ArbPeriod is a dummy variable equal to one for convertible bond offerings announced in the Arbitrage period, which ranges from 1/1/2000 to 14/9/2008, and equal to zero otherwise. PostLehmanPeriod is a dummy variable equal to one for convertible bond offerings announced during in the Post-Lehman period, which ranges from 15/9/2008 to 31/12/2009, and equal to zero otherwise. ArbDemand/SO is the estimated arbitrage-related increase in short interest relative to shares outstanding, calculated for each convertible using the coefficients from the regression in Column (1) of Table 1 in all Columns except Columns (6) and (7). In Columns (6) and (7), ArbDemand/SO is calculated using the coefficients from the regressions in Columns (3) and (4) of Table 1, respectively. All other explanatory variables are defined as outlined in Appendix A, B, 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)	(6)	(7)	(8)
ArbPeriod	-2.830***	-1.630**	1.263	0.479	1.304	1.273	1.255	0.936
	(-8.30)	(-2.36)	(1.27)	(0.35)	(1.51)	(1.28)	(1.26)	(0.68)
PostLehmanPeriod	-7.160***	-4.273***	-2.852	-3.045	-4.408***	-2.928	-2.793	3.722
	(-6.25)	(-2.98)	(-1.58)	(-1.03)	(-2.97)	(-1.64)	(-1.54)	(0.71)
Issuer-specific								
StockRunup		-0.150	-0.855	-1.091	-0.651	-0.855	-0.853	-0.742
		(-0.16)	(-0.85)	(-0.83)	(-0.67)	(-0.85)	(-0.85)	(-0.76)
Slack		-1.438	-2.593**	-2.747*	-1.741	-2.587**	-2.597**	-2.584**
		(-1.22)	(-2.09)	(-1.75)	(-1.46)	(-2.09)	(-2.10)	(-2.12)
Tax		1.674	-0.673	-1.954	-0.810	-0.606	-0.725	-0.072
		(0.27)	(-0.11)	(-0.22)	(-0.13)	(-0.09)	(-0.11)	(-0.01)
LTDebt		-2.084*	-0.527	-0.822	-0.674	-0.542	-0.518	-0.594
		(-1.84)	(-0.43)	(-0.51)	(-0.58)	(-0.44)	(-0.42)	(-0.48)
RelVolatility		-0.314*	-0.478***	0.003	-0.253	-0.477***	-0.478***	-0.468***
		(-1.94)	(-2.74)	(0.01)	(-1.58)	(-2.73)	(-2.74)	(-2.69)
MarkettoBook		0.065*	0.011	0.001	0.011	0.011	0.011	0.011
		(1.81)	(0.35)	(0.02)	(0.35)	(0.36)	(0.35)	(0.34)
FixedAssets		0.201	-0.219	0.202	-0.303	-0.208	-0.227	-0.220
		(0.27)	(-0.28)	(0.19)	(-0.40)	(-0.27)	(-0.29)	(-0.28)
LogAssets		0.353	0.186	0.469**	0.035	0.187	0.187	0.216
		(0.36)	(1.16)	(2.04)	(0.22)	(1.17)	(1.16)	(1.38)

Table 4 (continued)

Variable		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Parameter estimate (t-value)								
Issue-specific									
CreditRating			0.045	0.081	-0.051	0.025	0.081	0.082	0.082
			(0.71)	(1.16)	(-0.48)	(0.39)	(1.16)	(1.17)	(1.17)
Proceeds			0.315	1.030	1.392	0.541	1.025	1.034	1.085
			(0.45)	(1.40)	(1.36)	(0.81)	(1.39)	(1.40)	(1.47)
ConvPremium			-0.009	-0.019	-0.035*	-0.021	-0.019	-0.019	-0.019
			(-0.57)	(-1.25)	(-1.69)	(-1.41)	(-1.24)	(-1.25)	(-0.73)
ConvPremium*ArbPeriod									0.010
									(0.33)
ConvPremium*PostLehmanPeriod									-0.263
									(-1.46)
Maturity			-0.002	-0.027	-0.054	-0.007	-0.026	-0.028	-0.030
			(-0.09)	(-1.20)	(-1.57)	(-0.31)	(-1.16)	(-1.24)	(-1.32)
144A			0.194	0.284	0.816	0.063	0.284	0.283	0.386
			(0.35)	(0.48)	(1.18)	(0.11)	(0.48)	(0.48)	(0.66)
Issue=Announcement			-0.828**	-0.713	-1.353*	-0.718*	-0.708	-0.717	-0.751*
			(-1.96)	(-1.60)	(-1.65)	(-1.69)	(-1.59)	(-1.61)	(-1.69)
Underpricing					-5.836**				
					(-2.38)				
Macroeconomic									
InterestRate			0.290**	0.308**	0.221	0.209	0.306**	0.310**	0.335**
			(2.15)	(2.22)	(0.73)	(1.55)	(2.20)	(2.23)	(2.42)
TermSpread			-0.362**	-0.331**	-0.213	-0.256*	-0.329**	-0.332**	-0.333**
			(-2.52)	(-2.23)	(-1.13)	(-1.77)	(-2.22)	(-2.23)	(-2.26)
MarketRunup			0.385	2.225	6.280	1.854	2.187	2.255	2.235
			(0.13)	(0.72)	(1.47)	(0.62)	(0.70)	(0.73)	(0.72)
MarketVolatility			-11.113***	-13.267***	-10.723*	-11.154***	-13.250***	-12.278***	-14.727***
			(-2.84)	(-3.23)	(-1.80)	(-2.81)	(-3.22)	(-3.23)	(-3.51)

Table 4 (continued)

Variable	Parameter estimate (t-value)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Arbitrage shorting								
ArbDemand/SO*TradInvestorPeriod			-27.691***	-53.438*		-27.751***	-27.613***	-27.187**
			(-2.61)	(-1.77)		(-2.60)	(-2.60)	(-2.55)
ArbDemand/SO*ArbPeriod			-171.074***	-160.746***		-172.352***	-169.990***	-168.701***
			(-5.03)	(-5.03)		(-5.10)	(-4.98)	(-4.94)
ArbDemand/SO*PostLehmanPeriod			-82.158*	-82.158*		-78.478*	-84.980*	-98.463**
			(-1.69)	(-1.69)		(-1.66)	(-1.71)	(-2.42)
DeltaNeutral/SO*TradInvestorPeriod					-2.316*			
					(-1.75)			
DeltaNeutral/SO*ArbPeriod					-27.815***			
					(-5.89)			
DeltaNeutral/SO* PostLehmanPeriod					-0.430			
					(-0.33)			
Intercept	-1.689***	-1.738	0.709	0.418	1.101	0.696	0.713	0.572
	(-9.11)	(-0.88)	(0.33)	(0.14)	(0.54)	(0.33)	(0.34)	(0.28)
Adj. R^2	7.40%	10.35%	13.12%	9.78%	13.41%	13.80%	13.12%	10.81%
N	1,436	1,436	1,436	788	1,436	1,436	1,436	1,436
Period	1984-2009	1984-2009	1984-2009	1991-2009	1984-2009	1984-2009	1984-2009	1984-2009

Table 5: Analysis of stock returns, delta, and required short selling following convertible debt issues

This table analyses abnormal stock returns as well as changes in delta and in required arbitrage-related short selling (as captured by DeltaNeutral) in the days following convertible bond issuance. Trading days are measured relative to the convertible bond issue date. Panels A and B present cumulative abnormal stock returns (CARs) following convertible bond issues, calculated using standard event study methodology. 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. Panel A present average CARs over the windows (2, 5) and (2, 10), as well as standard deviations (std.dev) of these CARs. We use a Patell Z-test to examine whether individual CARs are equal to zero. We use a Kruskal-Wallis test to jointly examine differences between the CARs across all three sub-periods. Panel B presents the results of a regression analysis of the CARs over the windows (2, 5) and (2, 10) on a number of potential determinants. TradInvestorPeriod is a dummy variable equal to one for convertible bond offerings announced in the Traditional Investor period, and equal to zero otherwise. ArbPeriod is a dummy variable equal to one for convertible bond offerings announced in the Arbitrage period, and equal to zero otherwise. PostLehmanPeriod is a dummy variable equal to one for convertible bond offerings announced during in the Post-Lehman period, and equal to zero otherwise. ArbDemand/SO is the estimated arbitrage-related increase in short interest relative to shares outstanding, calculated for each convertible using the coefficients from the regression in Column (1) of Table 1. Amihud captures illiquidity of the issuer stock and is defined as outlined in Appendix A. t-statistics, estimated using White (1980) heteroskedasticity-robust standard errors, are in parentheses. In Panels A and B, *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively. N denotes the number of observations. Panel C presents changes in deltas and required short selling for achieving a delta-neutral position (DeltaNeutral) in the ten trading days following the convertible bond issue date. Delta and DeltaNeutral are calculated as outlined in Appendix B. Column (1) provides the average daily increase in delta with respect to its previous day value. Column (2) provides the average absolute change in delta with respect to its previous day value. Column (3) provides the average daily change in DeltaNeutral (as a result of the change in delta) with respect to its previous day value. Column (4) provides the average cumulative increase in DeltaNeutral since the issue date, as a percentage of the value of DeltaNeutral on the issue date. Column (5) provides the average cumulative absolute change in DeltaNeutral since the issue date, as a percentage of the value of DeltaNeutral on the issue date.

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)	-0.023%	5.257%	0.503%***	6.112%	−1.848%	11.516%	0.000
CARs(2, 10)	-0.459%**	8.253%	0.541%***	8.793%	−3.391%*	11.492%	0.000
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)
ArbDemand/SO*TradInvestorPeriod	0.766	-2.199
	(0.07)	(-0.13)
ArbDemand/SO*ArbPeriod	41.310***	50.975*
	(2.32)	(1.88)
ArbDemand/SO*PostLehmanPeriod	-33.241	-41.913
	(-0.82)	(-0.95)
Amihud	-0.050	0.070
	(-0.48)	(0.33)
Intercept	-0.243	-0.515
	(-0.75)	(-1.07)
Adj. R^2	0.76%	0.49%
N	1,436	1,436
Period	1984-2009	1984-2009

Panel C: Average daily changes in delta and DeltaNeutral following convertible bond issuance

| Trading day	Delta			DeltaNeutral	
	Average daily increase	Average absolute change	Average daily increase	Average cumulative increase as % of day-0 value	Average cumulative absolute change as % of day-0 value
	(1)	(2)	(3)	(4)	(5)
1	-0.00050	0.00214	-10,642	-0.07%	0.29%
2	-0.00016	0.00281	-1,371	-0.07%	0.57%
3	0.00025	0.00224	-694	-0.03%	0.69%
4	0.00032	0.00227	6,172	0.02%	0.79%
5	-0.00004	0.00215	-3,963	0.02%	0.86%
6	0.00020	0.00230	809	0.05%	0.95%
7	0.00016	0.00224	5,303	0.07%	0.98%
8	0.00021	0.00209	5,870	0.09%	1.00%
9	0.00008	0.00235	-982	0.11%	1.08%
10	0.00023	0.00230	2,438	0.16%	1.16%

Figure 1: **Quarterly number of convertible arbitrage-related articles appearing in the Factiva database**

This figure shows the number of news sources (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.
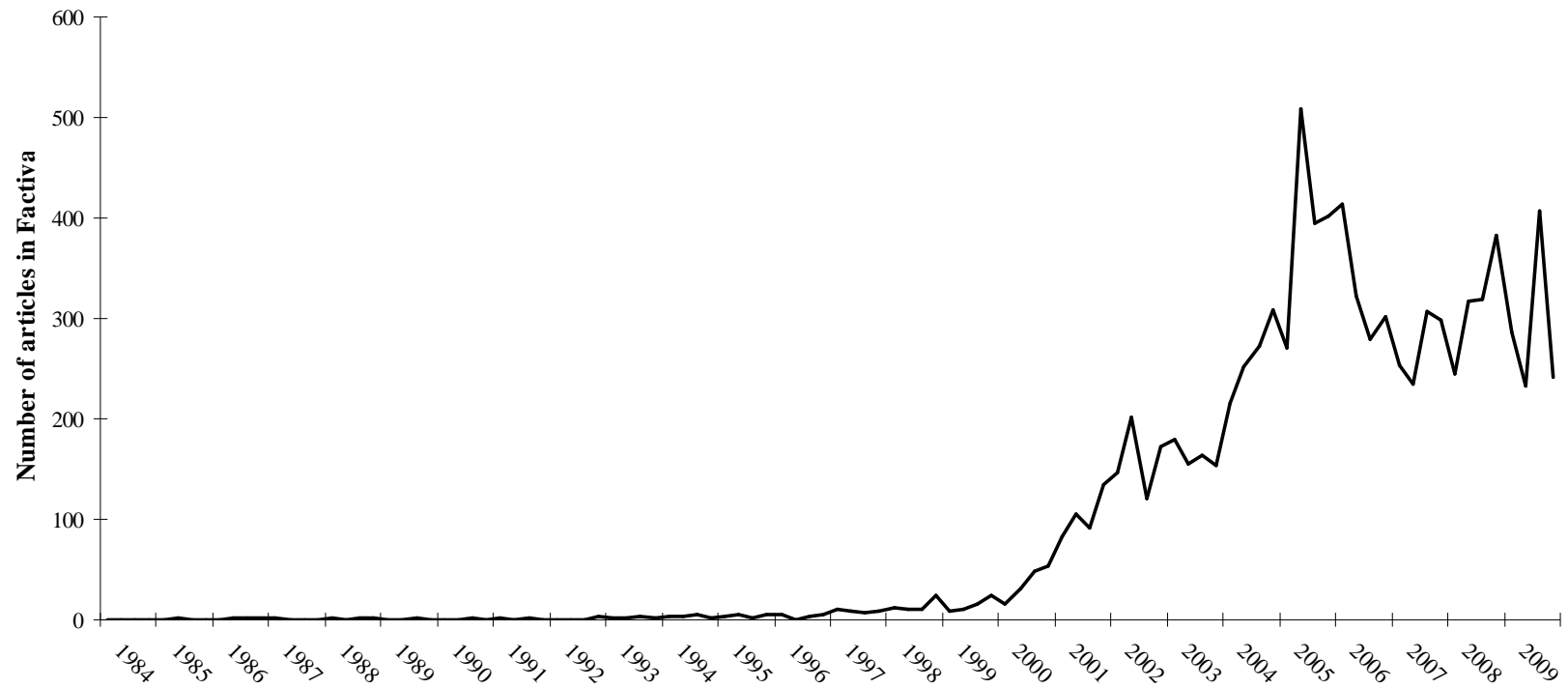
Figure 2: Average quarterly stockholder wealth effects of convertible, equity, and straight debt announcements

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.

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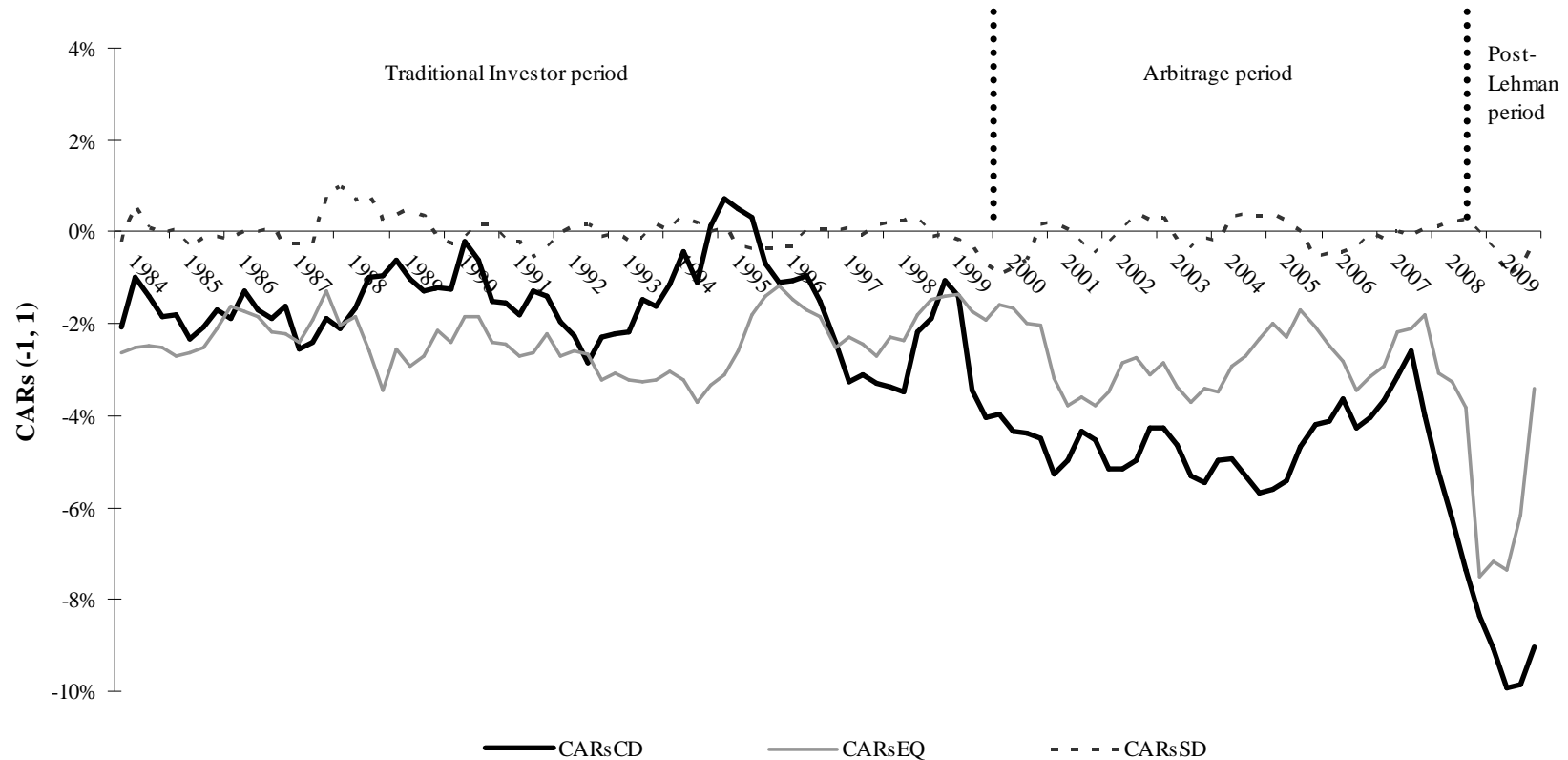
Appendix A: Detailed definitions of issuer-specific, issue-specific, and macroeconomic variables included in the analysis

This Appendix provides a definition of the explanatory variables used in the paper, listed in alphabetical order. Issue characteristics are obtained from SDC. Balance sheet and income statement variables are obtained from Compustat Fundamentals Annual and measured at the fiscal year end preceding the convertible bond announcement date, unless noted otherwise. # indicates a Compustat Fundamentals Annual data item. Stock price data are obtained from CRSP. Trading days are measured relative to the convertible bond announcement date. Macroeconomic characteristics are obtained from Datastream, unless noted otherwise.

Variable name	Classification	Calculation
144A	Issue-specific	Dummy variable that takes the value one for offerings made under SEC Rule 144A.
Amihud	Issuer-specific	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). For expositional purposes, we multiply this ratio by 10^6.
CAFactiva	Macroeconomic	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	Macroeconomic	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.
ConvPremium	Issue-specific	Conversion premium of the convertible, expressed as a percentage. It is calculated by dividing the conversion price by the stock price measured on trading day -5, and subtracting one from this ratio.
CreditRating	Issue-specific	Moody's credit rating of the convertible at the moment of issuance. Consistent with Chan and Chen (2007), we assign a value of one to Moody's Aaa ratings and add a value of one to each subsequent rating. If the convertible has no Moody's rating but is rated by Standard and Poor's, we convert the S&P rating into the equivalent Moody's rating. In line with Loncarski et al. (2009), we assign a rating of Baa2 to unrated convertibles.
Delta	Issue-specific	Sensitivity of the convertible bond value to its underlying common stock value, measured as outlined in Appendix B.
DeltaNeutral/SO	Issue-specific	Number of shares that need to be shorted for arbitrageurs to obtain a delta-neutral position as of the issue date, calculated as outlined in Appendix B, divided by the number of shares outstanding measured on trading day -20.
DividendPaying	Issuer-specific	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.
FixedAssets	Issuer-specific	Plant, property, and equipment (#8) divided by total assets (#6).

Gamma	Issue-specific	Sensitivity of the convertible bond delta to its underlying common stock value, measured as outlined in Appendix B.
GammaBear/SO	Issue-specific	Number of shares that need to be shorted for arbitrageurs to obtain a bearish gamma hedge as of the issue date, calculated as outlined in Appendix B, divided by the number of shares outstanding measured on trading day -20.
GammaBull/SO	Issue-specific	Number of shares that need to be shorted for arbitrageurs to obtain a bullish gamma hedge as of the issue date, calculated as outlined in Appendix B, divided by the number of shares outstanding measured on trading day -20.
InstitOwnership	Issuer-specific	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).
InterestRate	Macroeconomic	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.
Issue=Announcement	Issue-specific	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.
LogAssets	Issuer-specific	Natural logarithm of total assets (#6), deflated by the Consumer Price Index (obtained from Datastream).
LTDebt	Issuer-specific	Long-term debt (#9) divided by total assets (#6).
MarketRunup	Macroeconomic	Return on the S&P 500 index over the quarter prior to issuance.
MarkettoBook	Issuer-specific	Market value (calculated as #25 multiplied by #199) divided by the book value of common equity (#60).
MarketVolatility	Macroeconomic	Annualized market return volatility, calculated from daily returns on the S&P 500 index over the quarter prior to issuance.
Maturity	Issue-specific	Convertible bond maturity, measured as of the issue date (obtained from SDC).
Proceeds	Issue-specific	Relative size of the convertible bond offering, calculated as the offering proceeds divided by total assets (#6).
RelVolatility	Issuer-specific	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.
Slack	Issuer-specific	Cash and short-term investments (#1) divided by total assets (#6).
StockRunup	Issuer-specific	Stock return over the window (-60, -2) relative to the announcement date.
Tax	Issuer-specific	Income taxes paid (#16) divided by total assets (#6).
TermSpread	Macroeconomic	Difference between yields on ten-year U.S. Treasury Bonds and three-month Treasury Bills, averaged over the quarter prior to issuance.
Underpricing	Issue-specific	Underpricing of the convertible bond as of its issue date, measured as outlined in Appendix C.
Volatility	Issuer-specific	Annualized stock return volatility, estimated from daily stock returns over the window (-240, -40) relative to the convertible bond announcement date.
ZeroCoupon	Issue-specific	Dummy variable equal to one for zero-coupon convertibles.

Appendix B: Calculation of DeltaNeutral, GammaBear, and GammaBull

DeltaNeutral 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 et al. (2011), we calculate this variable as follows:

$$DeltaNeutral = \frac{number\ of\ convertibles\ issued \times face\ value \times delta}{conversion\ price} \qquad (1)$$

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 Delta as follows:

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

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 relative to the announcement date (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 stock return Volatility, and T the convertible bond Maturity (both measured as outlined in Appendix A).[18]

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[18] As argued in Zabolotnyuk et al. (2010), a potential disadvantage of delta is that it does not capture convertibility and callability characteristics. As such, delta provides an incomplete measure for the equity component size of convertibles. However, the purpose of the delta measure included in the DeltaNeutral

Arbitrageurs may also exploit the convertible's gamma to obtain incremental profits. Gamma measures the sensitivity of the convertible's delta to underlying stock price movements. In line with Fabozzi et al. (2009), we calculate gamma as:

$$Gamma = e^{-\delta T} N'(d_1) = e^{-\delta T} \frac{\varphi\left\{\dfrac{ln(\dfrac{S}{X})+(r-\delta+\dfrac{\sigma^2}{2})T}{\sigma\sqrt{T}}\right\}}{S\sigma\sqrt{T}}, \qquad (3)$$

with φ the probability distribution function of the standard normal distribution, and all other parameters defined as in the context of Equation (2). Consistent with Fabozzi et al. (2009), we consider a bearish gamma strategy in which arbitrageurs buy the convertible and short-sell Delta plus 0.09, and a bullish gamma strategy in which they buy the convertible and short sell delta minus 0.09. We calculate GammaBear and GammaBull values using Equation (1), but replacing delta with delta plus 0.09 and delta minus 0.09, respectively.

Appendix C: Calculation of convertible debt underpricing at issuance

In line with Chan and Chen (2007) and De Jong et al. (2011), we define initial Underpricing as the difference between the convertible 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

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variable is to replicate the inputs that are actually used by arbitrageurs in their 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 DeltaNeutral.

Fernandes (1998) model, which is widely used in other studies on convertible bond underpricing (Ammann et al., 2003; Chan and Chen, 2007; Loncarski et al., 2009; De Jong et al., 2011). 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);[19] credit spreads of similarly-rated corporate straight debt (obtained from Datastream);[20] conversion ratios and call schedules; dividend yield for the fiscal year preceding the announcement date (obtained from Compustat Fundamentals Annual by dividing #26 by #199), price of the underlying stock averaged between trading days -12 and -2 prior to the announcement date; and Volatility calculated as outlined in Appendix A.

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

[20] Since Datastream discontinues the provision of credit spreads as of the end of 2008, 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 also used other benchmark maturities (7-, 10-, and 30-year Treasury Bond yields), but found that 20-year yields result in spreads with the highest correlation and the smallest difference with the credit spreads reported by Moody's.