

Convertible Bond Arbitrageurs as Suppliers of Capital

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Convertible Bond Arbitrageurs as Suppliers of Capital

This paper examines the potential impact of capital supply on security issuance. We focus on the role of convertible bond arbitrageurs as suppliers of capital to convertible bond issuers. We estimate a simultaneous equations model of demand and supply of convertible bond capital, linking the time series of aggregate convertible bond issuance to measures of capital supply: convertible bond arbitrage hedge fund flows, returns, and a proxy for arbitrageurs' use of leverage. We find that issuance is positively and significantly related to increases in all three supply measures. To provide further interpretation, we use the September/October 2008 short selling ban as a natural experiment to examine the impact of an exogenous shock to the supply of capital from arbitrageurs. Results from both empirical approaches provide evidence that the supply of capital from convertible bond arbitrageurs impacts issuance.

Consistent with the Modigliani and Miller (1958) assumption of perfect supply of capital, most literature on firms' capital structure and issuance decisions has focused on demand-side determinants. Recent evidence (Faulkender and Petersen (2006); Sufi (2009); Lemmon and Roberts (Forthcoming); Massa, Yasuda, and Zhang (2008); and Leary (2009)) has called into question this widespread assumption that the supply of capital is frictionless, and highlights the need for an improved understanding of the precise role of supply. This paper uses the convertible bond market to shed light on this question. In particular, we investigate the role of convertible bond arbitrageurs as suppliers of capital.¹

Convertible bonds have been an important source of financing for a wide variety of firms, and have been particularly popular among distressed firms with depressed equity prices. While much smaller than the market for straight debt, the convertible bond market has, at times, been comparable in size to the market for new equity issues.² The convertible bond market provides a useful laboratory for studying the role of capital supply on issuance. One reason is that suppliers as a group are fairly well defined. Convertible bond arbitrage hedge funds are widely believed to purchase more than 75% of primary issues of convertible debt.³ By focusing on a market in which convertible bond arbitrage hedge funds account for such a large fraction of primary market activity, we are able to isolate important measures of capital supply (such as hedge fund flows). For example, in 2007, total convertible bond issuance was \$56 billion, an increase of more than 70 percent from the prior year. Over the same period, net flows into convertible bond arbitrage hedge funds increased 17 percent from the prior year. That variation in supply of capital to hedge funds is observable (fund flows are reported and available in widely studied databases) greatly improves the analysis; however, a second useful aspect of focusing on convertible bonds is that we can verify the underlying assumption that arbitrageurs

are important by using aggregate market data on short selling at the time of convertible bond issuance. Short selling activity at the time of issuance is consistent with arbitrage activities in the market for issuers' stock.⁴

The primary aim of this paper is to examine the relationship between convertible bond issuance and capital supply. We estimate a simultaneous equations model of demand and supply of convertible bond capital, linking the time series of aggregate convertible bond issuance to measures of capital demand as well as supply. In order to correctly estimate a system of supply and demand equations, we would ideally measure the time series of bond underpricing. Because these data are unobservable, we take an alternative approach. We first estimate theoretical bond values at-issue and then we use offering prices to calculate the offering discount relative to the bonds' estimated fair value. We then calculate the monthly time series of average bond underpricing.

We include three supply measures to help shed light on a potential role for arbitrageurs as suppliers of capital: convertible bond arbitrage hedge fund flows; fund returns (which, like flows, alter the size of assets under management); and the degree of leverage used by convertible bond arbitrageurs, captured by the change in short interest in issuers' stock near convertible bond issues. Given that arbitrageurs are primary market purchasers and that convertible bonds tend to be underpriced relative to fundamental value at issue (Kang and Lee (1996), Henderson (2006), and Chan and Chen (2007)), positive shocks to the capital positions of these arbitrageurs might result in upward bond price pressure, making issuance more attractive to firms. An observed positive relationship between issuance and any of these three variables would be in contrast to the classical assumption of perfect external capital markets (in the literature stemming from Modigliani and Miller (1958)), in which demand is the only determinant of firms'

financing decisions). We use two-stage least squares to account for potential endogeneity of flows and leverage and we find that issuance is positively and significantly related to increases in all three capital supply measures. Not only is issuance sensitive to the amount of capital available to hedge fund managers, but it is also sensitive to managers' use of the funds that they raise (i.e., leverage) and returns to the strategy. Our main results are not only statistically significant, they are also economically significant. Our main results suggest that, all else equal, a one standard deviation increase in hedge fund flows leads to a 38.6% increase in the supply of funds to issuers of convertible bonds.

To provide further interpretation of the main finding that supply of capital from arbitrageurs impacts issuance, we conduct an additional test. We use the ban on short selling in September and October 2008 as an exogenous shock to the supply of capital from convertible bond arbitrageurs. Because short selling plays an important role in convertible bond arbitrage strategies, the inability to short sell is expected to reduce arbitrageurs' willingness to supply convertible bond capital to firms. Our examination of convertible bond issuance patterns near the short sales ban reveals a significant decline in issuance, even after controlling for issuance of other types of securities. Taken together, results from both of the empirical approaches provide strong evidence that the supply of capital from convertible bond arbitrageurs impacts issuance, and are inconsistent with the traditional view that only demand matters for issuance.

A growing literature examining financing patterns by firms suggests that capital supply plays an important role in issuance decisions. For example, Faulkender and Petersen (2006) find that firms with effective access to public debt markets have substantially more debt in their capital structures. Sufi (2009) shows that firms with a loan rating use more debt after the introduction of syndicated bank loan ratings, which increases the supply of debt financing for

these firms. Lemmon and Roberts (Forthcoming) and Leary (2009) use events to show how shocks to the supply of credit impact financing and investment. Massa, Yasuda, and Zhang (2008) use bond turnover of a firm's institutional bond investors as a proxy for capital supply uncertainty and find that this measure has a negative impact on leverage.

Our paper makes three main contributions. First, we estimate a simultaneous equations model of supply and demand, in which we are able to link convertible bond issuance to convertible bond arbitrage hedge fund flows and other variables reflecting potential sources of capital supply. We include levered positions of convertible bond arbitrageurs (to our knowledge, a unique application) in order to account for leverage as a potential source of capital. We find that this significantly impacts issuance, even after controlling for direct measures of capital supply (i.e., fund flows). Second, our event-based analysis of the impact of the short selling ban of 2008 on issuance provides an opportunity to formally examine one potential implication of short sales regulation. Finally, beyond documenting a role for capital supply in convertible bond issuance, this paper suggests a possible role for hedge funds and arbitrageurs in markets that extends beyond trading activity and their impact on price efficiency.

The remainder of the paper is organized as follows. Section 1 describes the data and presents the main hypothesis to be tested. Section 2 presents the main analysis of issuance in a simultaneous demand and supply framework. Section 3 contains the analysis of the impact of the short selling ban on convertible bond issuance. Section 4 concludes.

1 Data and Hypotheses

1.1 Hypothesis Tests

The main goal of this paper is to examine the impact of capital supply on issuance. We study this question by measuring the impact of capital supply from convertible bond arbitrageurs on observed convertible bond issuance.⁵ Faulkender and Petersen (2006) find that market frictions can make the source of capital important in capital structure decisions. In particular, they report that firms with access to public debt markets have higher leverage. Our analysis addresses a similar issue in that we test whether variation in the size and activity of a particular source of capital supply (convertible bond arbitrageurs) impacts equilibrium issuance patterns. This would occur in the presence of market frictions. In the absence of frictions (the assumption underlying much of the capital structure literature), the observed level of convertible debt issuance is a function of demand for debt, which depends on the price of debt and demand factors, and the supply of debt, which depends on the price of debt and capital supply factors unrelated to the supply of capital from convertible bond arbitrageurs. In the absence of constraints on the supply of capital from arbitrageurs, the observed quantity of proceeds supplied will be unrelated to changes in the size and activity level of convertible bond arbitrageurs, who are main suppliers of capital to convertible bond issuers. However, in the presence of capital supply constraints, convertible bond arbitrageurs play an important role in the determination of the equilibrium amount of convertible debt financing firms obtain.

We test the basic hypothesis that the supply of capital from convertible bond arbitrageurs has no impact on convertible bond issuance using a simultaneous equations methodology, in which we explicitly model the relationships among quantities of convertible bond capital sup-

plied, capital demanded, and prices. If issuers face a binding constraint on the amount of available capital, then we expect to observe a positive relationship between issuance and the variables related to the capital supply from arbitrageurs. To shed further light on this hypothesis, we conduct an event study analysis, in which we use the short selling ban of 2008 as a natural experiment to test the impact of a shock to arbitrageurs' ability to supply capital to issuers. We then test the null hypothesis that this shock to supply from arbitrageurs did not impact issuance.

1.2 Data and Variable Construction

The sample period is from September 1995 through September 2008 for most of the analysis. The supply and demand estimation requires data on quantities and prices (in our case, underpricing) of convertible bonds, as well as supply and demand proxies.

1.2.1 Quantities and Prices

Proceeds *Proceeds* are defined as the sum of the dollar values of all convertible bonds issued during month t by U.S. issuers listed on NYSE and Nasdaq, as reported in SDC. Utilities (SIC codes 4900-4999) are excluded to avoid the potential concern that issuance policies are the result of regulation. The log of proceeds is used in the main regression analysis.

Underpricing Estimating supply and demand relationships requires a measure of convertible bond underpricing at the time of issuance. Because this is not directly observable, we estimate empirically the theoretical value of each sample bond i , P_i^{Model} , relative to the bond's offering price on the issue date. The estimation procedure follows Henderson (2006) and details are

provided in the Appendix. To quantify pricing in the new issues market, we compute the premium of the estimated bond value over the offering price as:

$$\frac{P_i^{Model}}{P_i^{Issue}} - 1, \quad (1)$$

where P_i^{Issue} denotes the issue price of the i th bond in the sample.

Using the above estimate of underpricing for each bond, we construct the time series of monthly average convertible bond underpricing. For each sample month t , during which N bonds are issued, the underpricing measure is:

$$Average\ Underpricing_t = \frac{\sum_{j=1}^N Underpricing_{j,t} * Proceeds_{j,t}}{\sum_{j=1}^N Proceeds_{j,t}}. \quad (2)$$

$Proceeds_{j,t}$ are the proceeds from the j th convertible bond offering in month t . *Average Underpricing_t* measures the value-weighted-average underpricing during month t . That is, the price at which issuers sell their bonds relative to the estimated value of these bonds, averaged across all issuers during each month. In periods where issuers sell convertible bonds at large discounts, the ratio of the model's estimated value to the offering price is higher. Thus, in periods with severe underpricing, the variable *Average Underpricing* is higher, indicating a higher ratio of estimated value to offering price. During periods in which issuers sell their bonds for amounts near estimated fair values, *Average Underpricing* will have lower values. If the issue price equals the fair value estimate the variable takes the value 0.⁶

Henderson (2006) and Chan and Chen (2007) report that at issue, convertible bonds are significantly underpriced relative to their fundamental values. In a perfect capital market, one would expect convertible bonds to be correctly priced; however, these issuers are often

low-rated firms which may face market frictions and financing constraints due to, for example, information asymmetry. We expect suppliers to be more willing to supply capital when *Average Underpricing* is high, and issuers more willing to issue capital when *Average Underpricing* is low.

There is evidence in the literature that firms consider current pricing when issuing securities. For example, in a survey of CFOs of large firms, Graham and Harvey (2001) report that 58% see convertible debt as a way to issue delayed common stock⁷ and that 42% of CFOs see convertible debt as less expensive than straight debt. Firms may have some flexibility in the timing of security issuance. If firms face capital supply constraints, then they may choose to raise more capital than currently needed for investment during favorable conditions and raise less during unfavorable ones. Julio, Kim and Weisbach (2007) find that macroeconomic conditions play an important role in the issuance of low quality debt. Baker and Wurgler (2002) argue that firms issue and repurchase equity to take advantage of market mispricing, and as a result, capital structure is the outcome of firms' past decisions to time the equity market. This "market timing" test has been controversial. For example, Alti (2006) finds that firms that have a history of high market to book values and issuance might have a common set of unobservable characteristics. He gets around this problem by looking only at IPO issuance during "hot" and "cold" markets. He finds that while "hot" market IPO firms initially have more equity, they increase their leverage ratios so that the impact of market timing on leverage disappears within two years

1.2.2 Supply Measures

Convertible Bond Arbitrage Hedge Fund Flows Hedge fund flows are interpreted as a potential source of financing for issuers and is a main variable of interest. *Flow* is defined as the percentage flow into convertible bond arbitrage hedge funds during month t . Consistent with the extant empirical literature, we calculate Flow using the change in assets adjusted for returns:

$$Flow_t = \frac{Assets_t - Assets_{t-1}(1 + r_t)}{Assets_{t-1}}, \quad (3)$$

where r_t is the asset return from time $t - 1$ to t , and $Assets_t$ represent the sum of all assets of convertible bond arbitrage funds at time t .⁸

Inputs to the *Flow* variable are from the TASS and CISDM/MAR databases. Both Live and Graveyard sub-databases were used to eliminate survivorship bias. These databases cover several hedge fund strategies, including convertible bond arbitrage. We focus only on funds that are dedicated to the convertible bond arbitrage in order to isolate variation in flows and returns to convertible bond arbitrage. The TASS database contains 247 convertible bond arbitrage hedge funds and CISDM database contains 218 convertible bond arbitrage hedge funds. We deleted hedge funds for which more than 25% of assets under management were missing. If assets were missing, flows were linearly extrapolated up to 3 missing asset observations. All asset values were converted to U.S. dollars. Several funds that report to the TASS database also report to the CISDM database. The TASS and CISDM databases were merged after accounting for hedge funds that report to both databases, resulting in a final sample of 247 unique convertible bond arbitrage hedge funds reporting to either or both databases over the September 1995 through September 2008 sample period. The average fund remains in the

sample for an average of 5.6 years (67 months), with an average of 97 convertible bond arbitrage hedge funds in each month of the sample period.

Convertible Bond Arbitrage Excess Returns Since fund size can also grow without new flows (through returns), we also control for convertible bond arbitrage fund returns as a potential source of capital. *Excess Return* is calculated as the monthly asset-weighted excess return (above the riskfree rate) to convertible bond arbitrage hedge funds, as reported in the TASS and CISDM databases. We use this as a supply variable in the proceeds supply regressions.

Arbitrage Activity and Leverage: ΔSI In addition to resources from flows and returns, convertible bond arbitrage fund managers may use leverage to finance their purchases of primary bond issues. Convertible bond arbitrageurs often take simultaneous short positions in the stock of the issuer. While we do not have direct data on convertible arbitrage activity in individual stocks, we are able to identify firms and dates on which we know that this strategy is likely to be used (convertible bond issuance dates) and we estimate convertible bond arbitrage activity by calculating changes in short selling at issuance.⁹

We obtain data on all convertible debt issues (public, private and Rule 144a) by U.S. publicly traded firms for the sample period from SDC. Monthly short interest data are from the NYSE and the Nasdaq and are matched with the SDC data using ticker, CUSIP and date identifiers. ΔSI is defined as the sum of the dollar change in short interest (short interest in issue month t minus short interest in the preceding month), divided by the market capitalization of all NYSE and Nasdaq securities during that month. We interpret this variable as aggregate convertible

bond arbitrage activity. It captures both funds buying bonds as well as their use of leverage.

ΔSI is a potentially important control variable in this analysis because it provides a measure of positions taken by arbitrageurs. Fund flows data in hedge fund databases are self-reported and therefore may provide an incomplete measure of convertible bond arbitrage activity. There may be mis-classification and funds reporting multiple strategies. Finally, this variable captures leverage which, even if we measured the assets of the funds perfectly, would be unobservable. Note that while it may be somewhat surprising that firms would be willing to issue convertible bonds if they expect that arbitrageurs will take short positions in their equity; however, Choi, Getmansky and Tookes (2009) find that the short selling due to convertible bond arbitrage activity actually improves equity market liquidity and has no negative impact on prices. In addition, Stein (1992) and Gomes and Phillips (2008) report less negative stock price reactions for convertible issues than for equity issues.

Other supply variables We include two additional supply variables, which are proxies for expected transactions costs associated with a dynamic convertible bond arbitrage strategy. A typical convertible bond arbitrage strategy employs delta-neutral hedging, in which an arbitrageur buys the convertible bond and sells short the underlying equity at the current delta. After establishing the initial position, which is set up so that no profit or loss is generated from very small movements in the underlying stock price, convertible bond arbitrageurs engage in dynamic hedging. If the price of the stock increases, the arbitrageur adds to the short position because the delta has increased. Similarly, when the stock price declines, the arbitrageur buys stock to cover part of the short position due to the decrease in delta. To capture expected transactions costs from dynamic hedging, we include VIX_t , the Chicago Board Options Ex-

change Volatility Index, a measure of the implied volatility of S&P 500. After controlling for underpricing, VIX_t captures the extent to which arbitrageurs expect to adjust their short positions as market prices evolve over time. The second measure is $SumDollarVol_t$, the monthly dollar volume (\$Trillion) on the NYSE and Nasdaq. This is a proxy for equity market liquidity. Liquid equity markets will increase arbitrageurs' ability to adjust short positions and therefore increase their willingness to supply convertible bond capital.

1.2.3 Demand Measures

The demand variables are of two types: financial constraints and investment demand. These are chosen to be consistent with findings in the literature, beginning with Fazzarri, Hubbard and Petersen (1988) that financial constraints impact both financing and investment. Because convertible debt has been a popular source of financing for firms approaching distress and those with declining equity performance, variation in financial constraints should explain variation in demand from firms for convertible debt financing. The amount of existing leverage is one such variable that is expected to impact the demand for convertible debt. This is because debt becomes riskier as firms become more levered, creating potential incentives problems. Green (1984) shows that convertible debt can be a solution to the risk-shifting problem when firms take on risky debt.¹⁰

We should note that our analysis is based on time series variation in aggregate issuance and aggregate demand. Our data limit our ability to provide cross-sectional evidence; however, the time series tests are still informative about the impact of financial constraints on firms' external financing decisions.

Financing Constraints There are four proxies for financial constraints:

1. *Cash Flow_t*, defined as the sum of earnings before extraordinary items and depreciation, divided by beginning-of-quarter capital. Lower cash flow is associated with more binding financial constraints.
2. *Leverage_t*, the lagged debt to total capital (lagged leverage is used in order to exclude the impact of contemporaneous convertible debt issuance). As leverage increases, firms approach their debt capacities and the risk of debt rises. Convertible bonds may be particularly appealing in this setting (see e.g., Green (1984) in which convertible bonds can solve incentive problems for firms with risky debt).
3. *Dividends_t*, the 12 month rolling average dividends, as reported in CRSP, divided by end-of-quarter capital. When dividend payouts are high, firms are less financially constrained.
4. *Cash Holdings_t*, defined as cash and short term investments divided by end-of-quarter capital. When there is more internal cash in the economy, firms are less financially constrained and are expected to rely less on external financing (due to the transactions costs associated of raising external capital).

These four variables are used in Almeida, Campello and Weisbach (2004) and are based on the Kaplan-Zingales (1997) Index.¹¹ In order to maximize the number of observations for these market-wide constraint measures, we include all non-missing observations for NYSE and Nasdaq firms based on information available in COMPUSTAT (for the *Leverage_t*, *Cash Flow_t*, and *Cash Holdings_t* variables) and CRSP (for *Dividends_t*). As a robustness check, we construct all variables based on a constrained sample, in which we include only those firms

with non-missing information on all four financing constraints measures. The average number of firms per month used to construct the financial constraints measures becomes 5,090, versus 6,016 for $Leverage_t$, 5,123 for $Cash\ Flow_t$, 5,880 for $Cash\ Holdings_t$ and 5,884 for $Dividends_t$. All results from this robustness analysis are very similar to those that are reported in the tables.

Investment Opportunities Q_t , the main proxy for investment opportunities, is defined as the book value of assets, plus end-of-quarter CRSP market value of equity, minus the book value of common equity, divided by total assets. In extended models, we include a second investment demand control, *Other Proceeds*, which are defined as the (log) sum of the dollar values of straight debt and equity issued during month t by U.S. issuers listed on NYSE and Nasdaq, as reported in SDC. This controls for time variation in overall financing demand not captured by Q .¹²

1.2.4 Sample: Summary Statistics

We begin the sample in September 1995 since we are unable to estimate reliably the underpricing measure at the monthly frequency prior to that month. Moreover, to adjust for survivorship bias in the hedge fund databases, the sample should be started after 1994.¹³ The sample period ends in September 2008, the date of the last available CRSP quarterly update. As can be seen from Figure 1, convertible bond issuance varies with both fund flows into convertible bond arbitrage hedge funds and with the estimate of the amount of convertible bond arbitrage activity in the underlying stock (the change in short interest). The plots in Figure 1 suggest that convertible bond arbitrageurs are an important source of capital. The correlations between quarterly proceeds and both percentage flows and the arbitrage activity proxy are

positive (.141 and .635, respectively) and statistically significant. Figure 1 reveals what appear to be trends in the data. In order to remove the trend effects, all variables for which we observe a significant coefficient a in the regression $y_t = \gamma + at$ are pre-whitened in all regressions.¹⁴

Summary statistics are presented in Table 1. There is significant issuance over the sample period, with median monthly issuance of nearly \$1.9 billion and 2.7% of all dollar issuance (i.e., total of equity, straight, and convertible debt). Convertible bond arbitrage hedge funds' assets average \$12.3 billion and average net inflows are 1.2%. When comparing flows to total issuance, it is important to note that, although arbitrageurs are a primary source of convertible bond capital, we would not expect the magnitudes of inflows to map one-to-one with issuance. There are several reasons for this. First, we only focus on dedicated convertible bond arbitrage funds. This excludes multi-strategy funds with substantial convertible bond arbitrage operations. Second, we do not capture the entire universe of convertible bond arbitrage hedge funds and are only able to observe those that self-report into TASS and CISDM. This means that some large funds are excluded. Our underlying assumption is that flow dynamics are representative of the industry. Third, hedge funds often use leverage, so flows are not a precise representation of the convertible bond purchasing power of these funds. The net capital outlay for a convertible arbitrage position is the cost of purchasing the bond less the proceeds from short-selling the issuer's shares to immunize the bond position from equity risk. Finally, convertible bond mutual funds may also purchase convertible bonds.¹⁵

The convertible bond arbitrage strategy was profitable over the sample period, with average monthly excess returns of 36 basis points. ΔSI , our proxy for convertible bond arbitrage activity (funds' use of leverage when purchasing convertible bonds) is .003% of total NYSE and Nasdaq market capitalization. This measure captures issue month shorting activity in

issuing firms' stock. We also observe substantial underpricing. During the sample period, the *Average Underpricing* variable has mean and median values of 7.14% and 5.79%, respectively. While the bond underpricing variable is calculated as an estimated when-issued premium, as opposed to the initial first-day excess return measure employed in the IPO literature, the magnitude of underpricing that we observe in our sample of convertible bonds is economically significant – nearly 40% of the underpricing observed in IPO issues over the same period.¹⁶ These levels are consistent with the average degree of convertible bond underpricing for the U.S. market reported by other researchers (see e.g., Chan and Chen (2007) and Henderson (2006)). Financial constraint measures are also in the table. Of them, cash flow is the most volatile (as one might expect). Of the supply proxies, dollar volume, the equity market liquidity proxy, is also rather volatile.

2 The Impact of Capital from Convertible Bond Arbitrageurs on Issuance

2.1 Empirical Model

Because quantities of convertible bonds issued and underpricing of these bonds are jointly determined, we use a simultaneous equations methodology. In particular, we use two-stage least squares to estimate the following system of supply and demand equations:

$$Proceeds_t^D = \alpha^D + \beta_1 Underpricing_t + \beta_2 X_t + \varepsilon_t, \quad (4)$$

$$Proceeds_t^S = \alpha^S + \gamma_1 Underpricing_t + \gamma_2 Z_t + \nu_t,$$

$$Proceeds_t^D = Proceeds_t^S.$$

The first equation in the system describes the demand (from firms) for convertible debt. $Underpricing_t$ is the value-weighted underpricing measure described in Section 1 and in the Appendix (in short, it is the ratio of theoretical bond value to issue price, minus one). Consistent with traditional models of supply and demand, $Underpricing_t$ is assumed to be endogenous. X_t is a vector of variables that proxy for current financial constraints: $Cash Flow_t$, $Leverage_{t-1}$, $Dividends_t$, $Cash Holdings_t$, and Q_t . These variables are based on the Kaplan-Zingales (1997) Index and are assumed to be exogenous.¹⁷ We expect that the quantity of convertible bond proceeds demanded by firms is decreasing in the extent to which they must discount them, $Underpricing_t$.¹⁸ We expect that financial constraints will increase equilibrium demand for convertible bonds. Financial constraints become more binding when internally generated funds are scarce and when firms face external financing frictions, which may be exacerbated by deteriorating performance. Poor economic performance may make straight bond financing expensive due to potential risk-shifting incentives (e.g., in Green (1984), convertible debt is a solution to the risk-shifting problem). Poor performance can also cause equity values to decline. If equity is currently undervalued, convertible debt may be a “backdoor” to equity financing (as in Stein, 1992). That is, we expect $Proceeds_t^D$ to be negatively related to $CashFlow$, $Dividends$ and $Cash Holdings$ and positively related to $Leverage$ and investment

opportunities, Q .

The second equation in the system describes the supply (from arbitrageurs) of convertible debt capital. $Underpricing_t$ is the underpricing measure described above (it is treated as an endogenous variable). Z_t is a vector of variables that proxy for capital supply from convertible bond arbitrageurs: $Flow_t$, $Excess\ Return_{t-1}$, VIX_t , $SumDollarVol_t$, and ΔSI_t . The ΔSI variable captures the tendency of firms to engage in convertible bond arbitrage activity and use leverage.¹⁹

All variables in Z are assumed to be exogenous, with the exception of $Flow$ and ΔSI , which may be determined jointly with equilibrium proceeds. These two endogenous variables are instrumented using estimates from first stage regressions. In the first stage regressions, we include contemporaneous flows into merger arbitrage hedge funds as an instrument for $Flow$. Merger arbitrage flows capture supply of capital to hedge funds that use short selling strategies, but is unrelated to convertible bond issuance. We use lagged ΔSI as an instrument for ΔSI . These instruments, all of the exogenous explanatory variables specified in the simultaneous equations system, and lags of all endogenous variables are included in the first stage regressions.

The $Proceeds_t^S$ equation is the main focus of the analysis. We expect that flows into convertible bond arbitrage hedge funds, past returns to these funds, and their ability to use leverage via short positions in the stock (ΔSI) will all increase convertible bond arbitrage hedge fund managers' willingness to supply capital to convertible bond issuers. The estimated coefficients on the supply measures (particularly $Flow_t$) are a main focus of this analysis since they allow us to measure the extent to which a particular type of capital supply impacts equilibrium issuance. We also expect that, after controlling for convertible bond underpricing, the expected transactions costs from convertible bond arbitrageurs' dynamic hedging strategies are increas-

ing in market volatility, VIX_t , and decreasing in market liquidity proxy $SumDollarVol_t$. This implies negative and positive signs on the estimated coefficients on VIX_t and $SumDollarVol_t$, respectively. Finally, we expect that the quantity of convertible bond proceeds supplied by arbitrageurs is increasing in the extent to which they are discounted, $Underpricing_t$.

The last equation in (4) defines the equilibrium condition that demand for convertible debt issuance equals supply.

2.2 Main Results

Results from the two-stage least squares estimates of Equations 4 are given in Table 2.²⁰ All standard errors are adjusted to be robust to heteroskedasticity and autocorrelation as in Newey and West (1987). There are three versions of the model, which differ only in the convertible bond arbitrage supply proxies included in the analysis. Model 1 uses $Flow_t$ as the only measure of supply from arbitrageurs. This is our preferred proxy for convertible bond arbitrageurs' willingness to provide greater quantities of capital since flows represent new, uncommitted capital.²¹ Model 2 includes both $Flow_t$ and $Excess Return_{t-1}$ since convertible bond arbitrage hedge fund managers might also be willing to supply a greater quantity of capital following periods of high returns to the strategy (their assets have just grown and they have more capital available to them). Model 3 includes $Flow_t$, $Excess Return_{t-1}$, and ΔSI_t in order to account for the possibility that convertible bond arbitrageurs' ability to use leverage via simultaneously short selling the underlying stock of the issuer increases capital available to them.

The results from estimating Model 1 are provided in Table 2 and show an estimated coefficient of -7.582 on the β_1 coefficient in the $Proceeds_t^D$ equation. Consistent with our hypothesis,

this implies that the quantity of convertible bond proceeds is decreasing in the amount by which firms must underprice them. This negative slope confirms a reasonable specification for the demand equation. The financial constraints measures all have the predicted signs, with the exception of *Cash Holdings_t*, which has an insignificant estimated coefficient. This is not very surprising since the regression controls for contemporaneous cash flow (which is negatively and significantly related to proceeds demanded).

In the *Proceeds_t^S* equation, we observe an insignificant estimated coefficient on the underpricing measure. The other estimated supply coefficients are precisely as predicted. The positive coefficient of 26.105 on *Flow_t* is not only statistically, but also economically significant. Because flows impact both proceeds and underpricing, underpricing will also shift when flows increase. Therefore the full impact of flows on proceeds supplied is calculated as: $\frac{\partial Proceeds_t^S}{\partial Flow}$ + $\frac{\partial Proceeds_t^S}{\partial Underpricing} * \frac{\partial Underpricing}{\partial Flow}$. Where: $\frac{\partial Proceeds_t^S}{\partial Flow}$ equals the coefficient on *Flow* in the *Proceeds_t^S* equation; $\frac{\partial Proceeds_t^S}{\partial Underpricing}$ equals the coefficient on *Underpricing* in the *Proceeds_t^S* equation; and $\frac{\partial Underpricing}{\partial Flow} = \frac{-\gamma_2^{Flow}}{\gamma_1 - \beta_1}$ (from the reduced form of Equations 4). Even after accounting for the underpricing channel, all else equal, a one standard deviation increase in hedge fund flows leads to a 38.6% increase in the supply of funds to issuers of convertible bonds.²²

When we include *Excess Return_{t-1}* (Model 2) and ΔSI_t (Model 3), we find additional evidence that supply of capital from convertible bond arbitrageurs is important to equilibrium issuance. Both of these variables have positive and significant effects on the equilibrium quantity of proceeds supplied. From Model 2, all else equal, a one standard deviation increase in flows results in a 40.6% increase in proceeds supplied and a one standard deviation increase in the prior month's returns results in a 18.4% increase in proceeds supplied. The results in Model 3 suggest that, all else equal: a one standard deviation increase in Flows results in a 28.5%

increase in proceeds supplied; a one standard deviation increase in the prior month's returns results in a 9.6% increase in proceeds supplied; and a one standard deviation increase in ΔSI_t results in a 31.0% increase in proceeds supplied. The latter (ΔSI) result not only provides evidence of arbitrageurs as sources of capital, but also suggests the potential importance of using data-driven strategies to infer arbitrage activities.

In Table 3, we repeat the analysis presented in Table 2, but we add an additional control variable, *Other Proceeds_t*. This variable is defined as the (log) sum of all straight debt and equity issues reported in the Securities Data Corporation's New Issues Database. It is included to control for firms' contemporaneous demand for new financing (in addition to what is captured by Q). The addition of the new variable, *Other Proceeds_t* is important, as it has a positive and significant estimated coefficient. The signs, significance and estimated magnitudes of the other variables in the system remain consistent.

It is widely believed that convertible bond arbitrage hedge funds are the primary purchasers of convertible debt issues.²³ However, other investors, such as mutual funds, also hold convertible debt. We use the Thomson 13F database to identify the mutual funds with the Lipper Objective Code CV ("Convertible Securities Funds"). There are 103 unique Convertible Securities Funds during our sample period, with asset size that is comparable to our sample of hedge funds (\$5.5 billion at the end of 1995; \$15.6 Billion as of March 2008).²⁴ The robustness analysis presented in the last columns of Table 3 repeats the main regression analysis (Table 2), but includes returns and flows from convertible mutual funds as a second potential source of capital. The main finding in Table 2 of the importance of the supply of capital from convertible bond arbitrage hedge funds (measured by both $Flow_t$ and ΔSI_t) is robust to including mutual funds. The coefficient on convertible bond arbitrage hedge fund excess return becomes

insignificant; however this is not surprising given that the correlation of .72 between that variable and mutual fund excess return (i.e., potential multicollinearity). Interestingly, we do not find evidence that mutual fund flows are important. In all three specifications, the estimated coefficient on mutual fund flows is insignificant. This does not appear to be due to collinearity between hedge fund and mutual fund flows, as the correlation between these two flow measures is -0.02 and is statistically insignificant. One interpretation of this result is that hedge funds are most active in primary issue markets (consistent with Mitchell, Pedersen, and Pulvino (2007) who report that convertible arbitrage hedge funds account for 75% of the market). Mutual funds may purchase more of their convertible bonds in secondary markets and/or they may focus more on purchasing preferred convertible stock.²⁵

Taken together, the results in Tables 2 and 3 from the simultaneous equations analysis reveal an important role for supply of capital from convertible bond arbitrageurs.²⁶ In the next section, we take an alternative approach to the analysis, which allows us to shed more light on this finding.

3 The Short Selling Ban of 2008: A Natural Experiment

In this section, we take an event-study empirical approach to examining the impact of capital supply from convertible bond arbitrageurs on issuance. We use the short selling ban of September 2008 to examine the impact of a shock to convertible bond arbitrageurs' ability to supply capital in the convertible bond market. The ability to sell short the equity of convertible bond issuers is critical to the convertible bond arbitrage strategy (both because of hedging equity risk and because the initial short position increases available capital). If supply

of capital matters to issuance, we should see a drop in convertible bond issuance during the time of the short selling ban.²⁷

In the second half of 2008, following steep equity price declines of financial issuers, the United States Securities and Exchange Commission (S.E.C.) took steps to restrict short selling in these firms in an effort to stabilize these downward price movements. On July 15, 2008, the S.E.C. issued an emergency order increasing restrictions on naked short selling in 19 financial stocks.²⁸ On September 19, 2008, the S.E.C. imposed much stronger restrictions and completely banned short selling in 799 stocks (mainly financial firms). Additional stocks were subsequently placed on this list, making the total number of banned stocks 893. This ban remained in effect through October 9, 2008.

Table 4 provides summary statistics on issuance during the year 2008. As can be seen from the table, there was a steep decline in convertible bond issuance during the September-October short selling ban. Average weekly proceeds decreased from \$944 million during the first half of the year to approximately \$20 million during the short selling ban. The number of issues also dropped, from nearly three per week during January through July 2008, to just one issue during the entire 3 week period of the short selling ban. Given that convertible bonds tend to be an important source of financing for firms in distress, this ban may have come at a particularly critical time for firms most vulnerable to a decline in the overall health of the economy. In fact, we observe increases in the fraction of convertible bond issuance relative to total issuance during the weeks prior to the ban, when overall economic conditions were deteriorating. Table 4 also provides data on straight bond issuance by non-investment grade issuers since convertible bond issuers are likely to choose between convertible bonds and low-rated straight debt. From the table, non-investment grade straight debt issuance also decreased during the ban; however,

unlike convertible debt issuance, the steep decline in the issuance of straight debt began well before the ban. By the time of the July 21 restrictions in the 19 financial stocks, average weekly issuance in non-investment grade straight debt was already at just over 50% of the levels seen during January through July, while convertible bond issuance remained nearly constant. While total issuance (straight debt, convertible debt, and equity by all firms, including investment grade issuers) also decreased during August and early September, it actually increased during the weeks of the short selling ban. It may be that some issuers, observing contraction in the convertible debt market decided to issue other types of securities for which there was still capital supply (for investment-grade issues). Following the ban, weekly issuance in low-rated straight debt increased 140 percent compared to issuance during the ban period; however the more than 340 percent increase in weekly convertible bond issuance was much steeper.

Panel B of Table 4 shows issuance patterns for financial firms, which accounted for 40 percent of the dollar value of all convertible bond issuance from January through mid-July. While the overall patterns in issuance are similar to those in Panel A, firms in this troubled sector saw even steeper declines in all types of issuance during the second half of 2008.²⁹ Financial firms (SIC codes 6000-6999) essentially vanished from the bond issuance market from September through December 2008, with the exception of one \$60 million issue. Panel C of Table 4 shows issuance for those stocks affected by the September-October short selling ban. While many of these are financial firms, the patterns are not identical to the financial firms sub-sample shown in Panel B (the correlation between financial firm and short sale ban dummies for issuers is .65). There was actually an increase in July and August convertible bond issuance for the firms that were subject to the September-October ban. Moreover, the increase in total issuance during the short selling ban was more dramatic for this group of firms. Panel D of the table shows

Troubled Assets Relief Program (TARP) allocations, which became available to financial firms during the last months of 2008.

To test for statistical significance of the decline suggested by the summary statistics, we propose a simple test. For the period January 1, 2008 through October 9, 2008 (the end of the short sales ban), we run a regression of weekly convertible bond issuance on dummy variables set equal to one if a short selling restriction is in effect during week t :

$$\begin{aligned} Proceeds_t = & \alpha + \beta_1 Other\ Proceeds_t + \beta_2 Junk\ Unrated\ Straight\ Debt_t + \\ & \beta_3 FIN19_3 + \beta_4 SHORTBAN_t + \varepsilon_t, \end{aligned} \quad (5)$$

where: $Proceeds_t$ is the (log) sum of the dollar value of all convertible bonds issued during week t . $Other\ Proceeds_t$ is the (log) sum of straight debt and equity issued during week t . This variable is included to control for time variation in firms' overall financing needs. $Junk\ Unrated\ Straight\ Debt_t$ is the (log) sum of junk or unrated straight debt issued during week t . This variable is included to control for the decrease in low-rated debt issuance during 2008. It allows us to distinguish whether the decline in convertible bond issuance observed in Table 4 is due to the short sale restriction or to a general collapse in the market for lower rated debt (in robustness analysis, we replace this measure with BAA-AAA credit spreads). $Fin19$ equals 1 if the emergency order increasing restrictions on naked short selling in 19 stocks was in effect during week t (i.e., July 20, 2008 through August 9, 2008). $ShortBan$ equals 1 if the full ban on short selling 799 stocks was in effect during week t (September 21, 2008 through October 11, 2008). Because weeks are measured from Sunday to Saturday, the dummy variables are set

equal to one if the restriction is in place during at least half of the week.³⁰ If these regulatory supply shocks to convertible bond arbitrageurs impact issuance, we will observe negative and significant coefficients on the dummy variables *Fin19* and *ShortBan*. Table 5 presents the results of the regression analysis.³¹

Panel A of Table 5 shows results of estimating Equation 5 for all firms in the sample. The standard errors are heteroskedasticity and autocorrelation consistent, as in Newey and West (1987). The negative and significant coefficient of -9.360 on *ShortBan* in Model 1 (Equation 5) is consistent with our hypothesis that the supply shock imposed via the S.E.C.'s short sale ban negatively impacted issuance. We observe an increase in overall convertible bond issuance during the earlier July restrictions on naked short selling (*Fin19*). This is somewhat surprising; however, it may be due to the sharp declines in non-convertible debt issuance during the early summer, as shown in Table 4. Firms may have issued convertible bonds because supply from hedge funds had not declined as rapidly as other sources of capital.³² As expected, the results from estimating Model 1 show that convertible bond issuance is positively and significantly related to contemporaneous issuance in straight debt and equity. This provides validation for including a control for market-wide swings in issuance, especially during the second half of 2008, when aggregate issuance saw steep declines. Interestingly, the coefficient on junk and unrated straight debt is negative. This suggests that the two types of debt are substitutes rather than complements. As an alternative control for the general decline in the market for low-rated bonds (shown in Table 4), in Model 2 we substitute *Junk Unrated Straight Debt* proceeds with the spread of BAA over AAA yields. The results of Model 2 are presented in Table 5 and are consistent with the findings in Model 1. In particular, we observe a negative and significant coefficient on *ShortBan*. Unlike the findings in Model 1, the coefficient on *Fin19* is insignificant.

This is expected since the July 19 order only strengthened existing restrictions on naked short selling and the universe of stocks was somewhat small (19 versus 799 in the September through October ban).

In interpreting the Model 1 and Model 2 results for the full sample of firms, one might be concerned that the short selling ban (*ShortBan*) focused mainly on financial firms. However, it is important to note that this ban took away an important hedging tool from convertible bond arbitrageurs and also introduced potential uncertainty regarding future short selling rules in all stocks. It also eliminated any financing provided by the short equity position. Moreover, even firms not typically classified as financials, such as General Motors and General Electric, were on the list of banned firms. Finally, the inability to short financials impacted the dynamic strategy (and presumably returns) of hedge funds, and may have decreased supply of capital available for other new issues.

As an additional check, we re-estimate Equation 5, but control for lagged convertible bond issuance. Results from this regression are given in Panel A, Models 3 and 4. These are consistent with the Model 1 and Model 2 findings, respectively. The main conclusions regarding the negative impact of the short sales ban on issuance remain unchanged across all four specifications.

Panel B of Table 5 shows results of estimating Equation 5 for financial firms only.³³ We find that the signs of the estimated coefficients on both *ShortBan* and *Fin19* are negative, but significant only for *ShortBan* in the Model 1 and Model 3 specifications. This may be due to noise associated with concentrating on one industry sector (financial firms, which limits the power of the test due to a small sample size), or to impending government financing programs (i.e., the Troubled Assets Relief Program).

To summarize, we find preliminary evidence that the short selling ban of 2008 cut off an important supply of capital to issuers of convertible debt and negatively impacted issuance for all firms. This evidence of reduced issuance following an exogenous shock to capital supply is consistent with earlier findings from the structural estimation of supply and demand of convertible debt (Table 2).

4 Conclusions

In the context of convertible bonds, we examine the role of capital supply in issuance decisions by firms. In particular, this paper uses a simultaneous equations methodology and links convertible bond issuance to a potentially important source of supply: convertible bond arbitrageurs. We document a strong link between variables that capture supply of capital (through hedge fund returns and fund flows, as well as past arbitrage activity) and bond issuance.

Our main finding is that convertible bond arbitrageurs' ability to supply convertible bond capital (i.e., fund flows) is an important driver of issuance. We also find that demand-side variables such as financial constraints and investment demand proxies (i.e., Q and total issuance in non-convertible debt and equity) all impact issuance in ways that are predicted by theory. In extended analysis that uses an event study methodology, we find additional evidence of a significant role for the supply of capital from arbitrageurs. The September-October 2008 ban on short selling resulted in an unfavorable shift in supply conditions and a decline in issuance.

Beyond providing evidence of an important role for capital supply in firms' capital structure and issuance decisions, our analysis sheds new light on the role of arbitrageurs in markets:

beyond their trading to correct mispricing, they are important suppliers of investment capital to firms.

Figures

Figure 1

Convertible Bond Proceeds and Capital Supply Variables

The figures plot the relationship between quarterly convertible bond issuance and two potential sources of capital supply: fund flows into convertible bond arbitrage hedge funds (Flow) and short selling in the underlying stock of the issuer (ΔSI). Quarterly percentage flow is defined as the sum of monthly dollar flow, divided by asset value at the end of the prior quarter. Quarterly ΔSI is defined as the sum of the dollar change in short interest (SI) of all convertible bond issuers in the current issue month (short interest in issue month t minus short interest in the preceding month), divided by the total market capitalization of all NYSE and Nasdaq firms.

Figure 2

Convertible Bond Quantities and Underpricing

This figure plots the relationship between quarterly convertible bond issuance (the sum of dollar proceeds during quarter t) and average monthly underpricing during quarter t . See the Appendix for estimation details for the underpricing variable.

Appendix: Theoretical Bond Price Calculation

This Appendix contains details of the convertible bond valuation model used to measure underpricing in the new issuance market. The convertible bond pricing model employed in this paper is a modified version of the binomial pricing model, similar to the procedure in Henderson (2006). The sample of new-issue convertible bonds comes from the SDC new issues database. All convertible bonds issued by public U.S. firms in U.S. marketplaces, including public and private issues, are included. We exclude all exchangeable and mandatory issues. Any issues missing important terms, such as the coupon rate or conversion ratio are eliminated from the sample.

For each convertible bond new issue, i , in our sample period, we compute the theoretical value of the bond at the time it is issued, designated as $P_{i,0}^{Model}$. The first step in this process is construction of the stock price tree. The model assumes that the issuer's stock price follows a geometric Brownian motion process with constant drift and volatility while having a constant hazard rate of default, λ , and recovery rate. The binomial tree is constructed using 50 time steps per year, or $dt = 1/50$. Thus, the number of time-steps on the binomial tree equals 50 times the years remaining until final maturity. At each time-step, the stock price S may move up (to uS) or down (to dS), where the size of the stock price changes is a function of the stock's return volatility:

$$u = e^{\sqrt{\sigma^2 - \lambda}dt}. \tag{A1}$$

$$d = \frac{1}{u}. \quad (\text{A2})$$

The historical return volatility, σ^2 , for each convertible bond issuer's stock is the standard deviation of daily historical stock returns during the window beginning 160 trading days leading up to the announcement and ending 20 days prior to the issuance. The default intensity, λ , is inferred from credit spreads at the time of the offering. Specifically, with an implied recovery rate R , the implied default intensity is:

$$\lambda = \frac{r_c - r_f}{1 - R}, \quad (\text{A3})$$

where r_c is the yield on straight bonds with the same credit yield as the issue, r_f is the risk-free yield, and R is the fraction of par expected to be recovered in the event of default. For convertible bonds that are not rated, we assume each issue is BBB rated. Based on Moody's statistics on historical recovery rates, we use 40% as the anticipated recovery rate.

The probability of the up- and down-steps, p_u and p_d , respectively, are computed as:

$$p_u = \frac{e^{(r-q)dt} - de^{-\lambda dt}}{u - d}, \quad (\text{A4})$$

$$p_d = \frac{ue^{-\lambda dt} - e^{(r-q)dt}}{u - d}, \quad (\text{A5})$$

where the parameter q is the continuously compounded dividend rate which is estimated as the trailing 12-month dividend rate on the issuer's stock. Since dividends are not paid continuously, the discrete distributions are converted to a continuous basis.

Using backwardation, construction of the convertible bond tree follows from the stock tree. Starting at the terminal node, corresponding to the final maturity date of the bond, the value of the bond is set equal to the maximum of the conversion value (conversion ratio times the stock tree price) or the par value of the bond plus the final coupon payment. Specifically, the expiration date T value (i.e., terminal node bond price) of the i th convertible bond in the sample is:

$$P_{i,T} = \text{MAX}[PAR + C, CR_i \times S_{i,T}], \quad (\text{A6})$$

where CR_i is the conversion ratio, or the number of shares into which the bonds may be converted at the investor's option, and $S_{i,T}$ designates the issuer's stock price which corresponds to the terminal nodes on the stock tree.

The prior nodes on the tree are populated by working backwards. Starting with the time-step immediately prior to expiration, the price of the bond is the maximum of the discounted expected payoff or the conversion value. Specifically,

$$P_{i,t} = \text{MAX}[e^{-r_f dt}(p_u P_{t+1}^u + p_d P_{t+1}^d + (1 - p_u - p_d)R \times PAR), CR_i \times S_{i,t}]. \quad (\text{A7})$$

Using call and put schedules compiled from SDC, Bloomberg, and Mergent for each bond, on all dates when the bonds are callable we impose the condition that the bond's value must be equal to the minimum of the price in the above equation, which we refer to as the value if the bond continues, or the maximum of the conversion value and the call price. Specifically,

$$P_{i,t}^{\text{Callable}} = \text{MIN}[P_{it}, \text{MAX}[CALL_{it}, CR_i \times S_{i,t}]], \quad (\text{A8})$$

where $CALL_{i,t}$ is the call price of the i th convertible bond at time t . Additionally, for any dates on which the bonds are puttable, we assume the bond holder will put the bonds back with the issuer at the put price, $PUT_{i,t}$, if that value is greater than the price in equation A.7 above:

$$P_{i,t}^{Puttable} = MAX[PUT_{it}, P_{it}]. \quad (A9)$$

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Notes

¹A convertible bond is a bond that may, at the option of the holder, be converted into stock at a specified price for a given time period. Convertible bond arbitrageurs aim to exploit mispricing in convertible bonds, typically by buying an undervalued convertible bond and hedging equity price risk by taking simultaneously a short position in the equity. Due to the conversion option, convertible bond purchasers may profit from equity price gains, but they also have downside protection since they are guaranteed bond payments.

²Convertible bond issuance (public, private and Rule 144a) in our sample of U.S. publicly traded firms was \$10.7 billion in 1996, \$43.1B in 2001 and \$55.9B in 2007. By comparison, US initial equity offerings were \$42.2B in 1996, \$34.3B in 2001, \$35.3B in 2007 (Ritter, 2008).

³For example, Mitchell, Pedersen, and Pulvino (2007), report that convertible arbitrage hedge funds account for 75% of the market. Even larger estimates can be found in the popular press.

⁴While it is possible for convertible bond arbitrageurs to hedge a short position in the bond with a long position in the stock at the time of issuance, this would be inconsistent with the empirical evidence in Agarwal, Fung, Loon and Naik (2008) that the return dynamics of convertible bond arbitrage hedge funds are explained by portfolios involving “delta hedged” positions, with long positions in convertible bonds and short positions in underlying equity. Choi, Getmansky and Tookes (2009) find large increases in short interest in convertible bond issuers at the date of issuance. Moreover, convertible bonds are underpriced at issue (See e.g., Chan and Chen (2007)). Despite the widespread belief that hedge funds hold positions for only short time horizons, the evidence from both of these papers is that convertible bond arbitrageurs maintain positions for a significant period of time. Choi, Getmansky and Tookes (2009) find that the increase in short interest observed at issuance persists; Chan and Chen (2007) find that convergence of

underpriced bonds to fundamental value takes several months, making it worthwhile for funds to hold the bonds.

⁵Agarwal, Fung, Loon and Naik (2008) study the risk and rewards of liquidity provision by convertible arbitrage hedge funds. Our analysis is different in that we link issuance activity with the capital supply from arbitrageurs.

⁶Note that this paper uses theoretical price for each issue, thus, we do not have to use ex-post data on realized returns.

⁷Stein (1992) claims that convertible bonds are a “backdoor” to equity financing. In this case, firms might substitute convertible bonds for equities when the former is “cheap.”

⁸Returns are net of fees. We assume that fees are withdrawn from the fund. However, sometimes, there is a provision for fees to be reinvested into the fund.

⁹While it is possible that valuation arbitrageurs also short the stock near convertible bond issuance, we would expect most of the short selling by these traders to occur at the announcement of the bond issue and not at the issuance date. Choi, Getmansky and Tookes (2009) find that most of the short selling by convertible bond arbitrageurs occurs near the issuance date.

¹⁰While Green (1984) focuses on post-issue risk shifting, Mayers (1998) introduces a sequential financing model and shows that callable convertible debt can solve over-investment problems.

¹¹Many of these measures of quarterly data are at the firm level; however, they are updated monthly and aggregated to the market level. For example, in the data, a firm with cash flow equal to X during a fiscal quarter ending in March will have cash flow value of $X/3$ for January, February and March. While a firm with a fiscal quarter ending in February and quarterly cash flow equal to Z will have cash flow of $Z/3$ for December, January and February, with a new cash flow value for the month of March.

¹²While our Tobin’s Q definition is widely used in the literature, it may suffer from

measurement error problems. See, for example, Whited (2001).

¹³The Graveyard database became available in 1994, thus, funds that were dropped from the Live database before 1994 are not included in TASS and CISDM/MAR databases.

¹⁴All variables except *CashFlow* and ΔSI are pre-whitened.

¹⁵In extended analysis (Table 3), we explicitly account for flows and returns from mutual funds with the Lipper Objective code CV (convertibles). There are 103 unique convertible mutual funds during our sample period.

¹⁶Initial public offering underpricing averaged 19.14 percent during the same period. (See Ritter, Jay, March 2008, “Some Factoids About the 2007 IPO Market.”)

¹⁷In unreported analysis, we have repeated the estimation using lagged Kaplan-Zingales (1997) measures. Results are unchanged.

¹⁸In our case, “demand” is the quantity of convertible bond financing demanded by issuers. In price-quantity space, this has an upward slope (i.e., the shape of a traditional supply curve). Because we are focusing on underpricing, rather than price levels, the expected slope is negative.

¹⁹The ΔSI variable captures both arbitrageurs’ supplying capital to issuers and their use of leverage (i.e., short positions in the underlying stock, which is a function of the issuer-determined bond conversion ratio). The component of ΔSI that reflects bond purchases is expected to be positively related to flows; however, the leverage component may provide incremental explanatory power.

²⁰First stage results are not reported, for brevity.

²¹Note that a firm issuing convertibles is not likely to know whether funds are flowing into or out of hedge funds. The main concern of firms is the amount and price of capital they raise at any given time period (firms’ bankers may be thought of as information intermediaries, keeping them informed as to how much and at what price they are able to issue in current markets). The equilibrium supply and demand framework allows us

to capture quantity and price-setting mechanism. We thank an anonymous referee for encouraging the structural simultaneous equations approach.

²²Note that in all three specifications, we observe negative and significant coefficients on lagged flows in the first stage underpricing regression. This suggests the mechanism by which flows lead to greater convertible bond issuance: they improve the terms (i.e., price) at which firms can issue convertibles.

²³This role for hedge funds is not limited to convertible bond markets. Evidence in Brophy *et. al* also suggests that hedge funds are important investors in private investments in public equity (PIPES).

²⁴The sample period only runs through March 2008 due to availability of the mutual fund data.

²⁵Convertible preferred stock issues were approximately 1/3 (in both number and dollar value) the issues of convertible debt during our sample period.

²⁶In unreported analyses, we examined whether fund flows cause issuance (in a Granger sense). We regressed convertible bond issuance on lagged supply of capital measures (fund flows, returns, and use of leverage), as well as lagged issuance and underpricing. We also regressed supply measures on lagged issuance, underpricing and supply. The results showed that lagged flows impact contemporaneous issuance; however, lagged proceeds do not impact new flows. This finding suggests uni-directional causality between proceeds and flows.

²⁷In fact, anecdotal evidence is consistent with this conjecture. See e.g., *WSJ*, “Short-Sale Ban Wallops Convertible-Bond Market,” 9/26/2008. One interesting example is Vineyard National Bank (VNBC), which announced a \$250 million convertible debt offering on 9/19/08. On that same day, VNBC was placed on the list of stocks subject to the short sales ban. In its subsequent 10K filing, the firm reports that, after discussions with investors, the 9/19/08 convertible debt offering was terminated and management

was pursuing a potential sale of the bank.

²⁸Before July 15, 2008, under Regulation SHO a short seller: i) must have borrowed the security or entered into an arrangement to borrow the security, or (ii) must have identified the shares to be borrowed and have reasonable grounds to believe that the security may be borrowed so that it can be delivered on the date delivery is due (the “locate” requirement). On July 15, 2008, the S.E.C. announced that, effective July 21, the S.E.C. would increase these requirements for the 19 of the most widely traded financial stocks. Short sellers in those stocks would either have to have borrowed the shares, or have a formal agreement from a lender on or before closing of a trade (this is only satisfied by the condition (i) above).

²⁹Bris (2008) studies the July 19 order increasing enforcement of naked short selling restrictions in 19 financial firms and finds heavy convertible issuance among these firms, with 6 issues during his sample period (Bank of America, Citigroup twice, Fannie Mae, Lehman Brothers, and Merrill Lynch). He finds that shorting activity before the SEC emergency order was highest for firms that were issuing convertible bonds, which suggests that significant shorting was done by convertible bond arbitrage funds rather than the valuation short sellers, who regulators feared might drive down prices. Choi, Getmansky and Tookes (2009) find that former type of short selling does not negatively impact equity prices.

³⁰For *Fin19*, these dates are July 20, 2008 through August 9, 2008. For *ShortBan*, these dates are September 21, 2008 through October 11, 2008. Results are not sensitive to redefining the dummies based on whether a restriction is in place on any day during week t .

³¹We have also estimated the model for the full year 2008. While the full year results also show a significantly negative impact of the short ban, the underlying assumption is that issuance patterns returned to their pre-ban levels. Given TARP infusions and other

market events post-October 9, using data through October 9 provides a more appropriate test.

³²There was also an increase in uncertainty during the spring and summer of 2008, which corresponds to increases in volatility. One explanation for why firms issue convertible bonds is that they require less interim cash flow than straight bonds. It is possible that when volatility increased, firms found it more desirable to issue convertible bonds.

³³We have repeated all analysis for the sub-sample of firms affected by the short selling ban of September and October 2008. While the signs of the estimated coefficients are consistent with the Panel B results for financial firms, they are all insignificant. This is not surprising, given that there were only 16 issues for firms affected by the ban during all of 2008.

Table 1
Convertible Bond, Hedge Fund and Firm Statistics

This table presents summary statistics on the sample of monthly convertible bond arbitrage hedge funds, proceeds and pricing, as well as firm characteristics. The sample period is from September 1995 through September 2008.

Proceeds are the sum of all proceeds of convertible bonds issued in the current month. *Proceeds/Total* is the total convertible bond proceeds divided by all issuance (proceeds from straight debt, equity, and convertible bonds) in the current month. *Underpricing* is the value-weighted monthly average model estimate for the underpricing of convertible bonds, expressed as percentage of offering price. See the Appendix for the details of estimating the theoretical bond pricing model. *Flow* is defined as the total monthly dollar flow into convertible bond arbitrage hedge funds, divided by total assets in the prior month. *Excess Return* is the asset-weighted monthly return in excess of risk-free rate. *Assets* represent the total assets under management by convertible bond arbitrage hedge funds in the current month. ΔSI is constructed by summing the dollar change in short interest (SI) of all convertible bond issuers in the current issue month (short interest in issue month minus short interest in the preceding month), divided by the total market capitalization of all NYSE and Nasdaq firms.

Firm characteristics are: Q , defined as the book value of assets, plus end-of-quarter CRSP market value of equity, minus the book value of common equity, divided by total assets; *Leverage*, the debt to total capital; *Dividends*, the 12 month rolling average dividends as reported in CRSP, divided by end-of-quarter capital; *Cash Holdings*, defined as cash and short term investments divided by end-of-quarter capital; *Cash Flow*, defined as the sum of earnings before extraordinary items and depreciation, divided by beginning-of-quarter capital. These variables are calculated using all non-missing observations for NYSE and Nasdaq firms. All quarterly COMPUSTAT data items are converted into monthly data. *VIX* is the Chicago Board Options Exchange Volatility Index, a measure of the implied volatility of S&P 500; *Dollar Volume* is the monthly dollar volume (\$Tril.) on the NYSE and Nasdaq.

N = 151

	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	AR(1)
Proceeds (\$billion)	2.649	1.880	13.943	0.090	2.507	2.132	0.440
Proceeds/Total (%)	3.456	2.666	11.953	0.150	2.421	1.358	0.265
Underpricing (%)	7.143	5.787	42.675	-8.712	8.251	1.030	0.125
Flow (%)	1.204	1.563	8.765	-7.771	2.794	-0.711	0.559
Excess Return (%)	0.361	0.464	4.409	-9.393	1.486	-1.839	0.312
Assets (\$billion)	12.278	10.942	31.068	1.211	8.148	0.723	0.996
ΔSI x 100 (%)	0.285	0.172	2.627	-0.754	0.428	2.742	0.400
Q	1.819	1.863	2.088	1.394	0.160	-0.873	0.931
Leverage (%)	33.918	33.646	49.609	31.717	1.979	3.686	0.852
Dividends x 100 (%)	7.727	7.415	13.843	6.089	1.124	2.120	0.811
Cash Holdings (%)	15.451	14.200	27.071	11.288	3.523	1.493	0.942
Cash Flow x 100 (%)	6.406	17.765	70.976	-102.690	28.639	-1.757	0.907
VIX (%)	20.022	19.980	39.390	10.420	5.860	0.434	0.821
Dollar Volume (\$trillion)	2.389	1.999	7.587	0.543	1.552	1.456	0.920

Table 2
Simultaneous Equation Model of Convertible Bond Financing

This table presents results of a simultaneous equation model of convertible bond issuance:

- (1) $ConvertibleProceeds_t^D = \alpha + \beta_1 Underpricing_t + \beta_2 X_t + \varepsilon_t$
- (2) $ConvertibleProceeds_t^S = \alpha + \gamma_1 Underpricing_t + \gamma_2 Z_t + v_t$
- (3) $ConvertibleProceeds_t^D = ConvertibleProceeds_t^S$

The dependent variables are $ConvertibleProceeds_t$, the (log) of convertible bond proceeds issued during month t . Superscripts D and S represent demand and supply, respectively. $Underpricing$ is the value-weighted monthly average model estimate for the underpricing of convertible bonds, expressed as percentage of offering price. See the Appendix for the details of estimating the theoretical bond pricing model.

X is a vector of demand variables and Z is a vector of supply variables. Explanatory variables in X are: Q_t , defined as the book value of assets, plus end-of-quarter CRSP market value of equity, minus the book value of common equity, divided by total assets; $Leverage_t$, the lagged debt to total capital (lagged leverage is used in order to exclude the impact of contemporaneous convertible debt issuance); $Dividends_t$, the 12 month rolling average dividends as reported in CRSP, divided by end-of-quarter capital; $Cash Holdings_t$, defined as cash and short term investments divided by end-of-quarter capital; $Cash Flow_t$, defined as the sum of earnings before extraordinary items and depreciation, divided by beginning-of-quarter capital. These are all proxies for firms' financial constraints and investment opportunities. The variables are calculated using all non-missing observations for NYSE and Nasdaq firms. All quarterly COMPUSTAT data items are converted into monthly data. Explanatory variables in Z are: $Flow_t$, defined as the total monthly dollar flow into convertible bond arbitrage hedge funds, divided by total assets in the prior month; $Excess Return_t$, defined as the asset-weighted monthly convertible bond arbitrage hedge fund return in excess of the risk-free rate; VIX_t is the Chicago Board Options Exchange Volatility Index, a measure of the implied volatility of S&P 500; $Dollar Volume_t$ is the monthly dollar volume (\$Tri.) on the NYSE and Nasdaq; and ΔSI_t , constructed by summing the dollar change in short interest in convertible bond issuers in the current issue month (short interest in issue month minus short interest in the preceding month), divided by the total market capitalization of all NYSE and Nasdaq firms. All variables in X and Z are assumed to be exogenous, with the exception of $Flow_t$ and ΔSI_t . $Underpricing$ is also assumed to be endogenous. These three endogenous variables are instrumented using estimates from first stage regressions (see main text for a full description).

Newey-West adjusted t-statistics are in parentheses. *, **, and *** denote 10%, 5% and 1% significance, respectively.

	Model 1			Model 2			Model 3		
	Coeff.	t-stat	t-stat	Coeff.	t-stat	t-stat	Coeff.	t-stat	t-stat
DEMAND FOR CAPITAL									
Intercept	0.110	(1.43)	0.112	0.112	(1.40)	0.104	(1.56)		
Underpricing _t	-7.582**	(-2.50)	-8.560***	-8.560***	(-2.60)	-4.155	(-1.58)		
Q_t	1.876	(1.01)	1.636	1.636	(0.84)	2.718	(1.62)		
Leverage _{t-1}	25.701***	(3.71)	26.745***	26.745***	(3.63)	22.040***	(3.75)		
Dividends _t	-1564.730**	(-2.10)	-1699.240**	-1699.240**	(-2.13)	-1093.380	(-1.47)		
Cash Holdings _t	1.048	(0.12)	0.277	0.277	(0.03)	3.750	(0.51)		
Cash Flow _t	-124.778**	(-2.37)	-126.434**	-126.434**	(-2.25)	-118.974***	(-2.83)		
Adj-RSq. (%)	13.50		13.54	13.54		16.14			
SUPPLY OF CAPITAL									
Intercept	-0.028	(-0.29)	-0.042	-0.042	(-0.47)	-0.380***	(-3.97)		
Underpricing _t	6.729	(1.45)	5.609	5.609	(1.40)	3.209	(1.25)		
Flow _t	26.105***	(2.98)	24.050***	24.050***	(3.22)	18.082***	(3.18)		
Excess Return _{t-1}			20.532**	20.532**	(2.49)	11.507*	(1.81)		
ΔSI_t (X 100)						128.377***	(4.58)		
VIX _t	-0.0626*	(-1.76)	-0.057*	-0.057*	(-1.84)	-0.046**	(-2.23)		
Dollar Volume _t	0.211*	(1.70)	0.201*	0.201*	(1.90)	0.152*	(1.92)		
Adj-RSq. (%)	4.46		9.18	9.18		26.22			

Table 3
Simultaneous Equation Model of Convertible Bond Financing: With Other Issuance Control and Mutual Fund Control

This table presents results of a simultaneous equation model of convertible bond issuance:

- (1) $ConvertibleProceeds_t^D = \alpha + \beta_1 Underpricing_t + \beta_2 X_t + \varepsilon_t$
- (2) $ConvertibleProceeds_t^S = \alpha + \gamma_1 Underpricing_t + \gamma_2 Z_t + \nu_t$
- (3) $ConvertibleProceeds_t^P = ConvertibleProceeds_t^S$

The dependent variables are *ConvertibleProceeds_t*, the (log) of convertible bond proceeds issued during month *t*. Superscripts *D* and *S* represent demand and supply, respectively. *Underpricing* is the value-weighted monthly average model estimate for the underpricing of convertible bonds, expressed as percentage of offering price. See the Appendix for the details of estimating the theoretical bond pricing model. *X* is a vector of demand variables and *Z* is a vector of supply variables. Explanatory variables in *X* are: *Q_t*, defined as the book value of assets, plus end-of-quarter CRSP market value of equity, minus the book value of common equity, divided by total assets; *Leverage_t*, the lagged debt to total capital (lagged leverage is used in order to exclude the impact of contemporaneous convertible debt issuance); *Dividends_t*, the 12 month rolling average dividends as reported in CRSP, divided by end-of-quarter capital; *Cash Holdings_t*, defined as cash and short term investments divided by end-of-quarter capital; *Cash Flow_t*, defined as the sum of earnings before extraordinary items and depreciation, divided by beginning-of-quarter capital. These are all proxies for firms' financial constraints and investment opportunities. The variables are calculated using all non-missing observations for NYSE and Nasdaq firms. All quarterly COMPUSTAT data items are converted into monthly data. *Other Proceeds_t* is the (log) monthly issuance of non-convertible debt and equity as reported in the *SDC Database*.

Explanatory variables in *Z* are: *Flow_t*, defined as the total monthly dollar flow into convertible bond arbitrage hedge funds, divided by total assets in the prior month; *Excess Return_t*, defined as the asset-weighted monthly convertible bond arbitrage hedge fund return in excess of the risk-free rate; *MF Flow_t*, defined as the total monthly dollar flow into convertible bond arbitrage mutual funds, divided by total assets in the prior month; *MF Excess Return_{t-1}*, defined as the asset-weighted monthly convertible bond arbitrage mutual fund return in excess of the risk-free rate; *VIX* is the Chicago Board Options Exchange Volatility Index, a measure of the implied volatility of S&P 500; *Dollar Volume* is the monthly dollar volume (\$Tril.) on the NYSE and Nasdaq; and ΔSI_t , constructed by summing the dollar change in short interest (\$B) of all convertible bond issuers in the current issue month (short interest in issue month minus short interest in the preceding month), divided by the total market capitalization of all NYSE and Nasdaq firms.

All variables in *X* and *Z* are assumed to be exogenous, with the exception of *Flow_t*, *MF Flow_t* and ΔSI_t . *Underpricing* is also assumed to be endogenous. These endogenous variables are instrumented using estimates from first stage regressions (see main text for a full description).

Newey-West adjusted t-statistics are in parentheses. *, **, and *** denote 10%, 5% and 1% significance, respectively.

	Other Issuance Control		Mutual Fund Flow Control	
	Coeff.	t-stat	Coeff.	t-stat
DEMAND FOR CAPITAL				
Intercept	0.112*	(1.89)	0.098	(1.32)
Underpricing _t	-4.638**	(-1.98)	-4.393	(-1.51)
Q _t	1.304	(0.74)	2.841	(1.61)
Leverage _{t-1}	14.586***	(2.72)	24.084***	(3.52)
Dividends _t	-544.637	(-0.78)	-1063.651	(-0.97)
Cash Holdings _t	-2.515	(-0.34)	4.536	(0.59)
Cash Flow _t	-105.006***	(-2.77)	-109.890**	(-2.27)
Other Proceeds _t	0.885***	(4.57)		
Adj-RSq. (%)	22.27		14.68	
SUPPLY OF CAPITAL				
Intercept	-0.380***	(-3.95)	-0.294***	(-3.54)
Underpricing _t	3.277	(1.56)	2.204	(1.01)
Flow _t	18.226***	(3.80)	16.964***	(3.53)
MF Flow _t			0.387	(0.15)
Excess Return _{t-1}	11.558*	(1.87)	-1.678	(-0.20)
MF Excess Return _{t-1}			6.446**	(2.38)
ΔSI_t (X 100)	128.044***	(4.66)	109.625***	(4.32)
VIX _t	-0.047***	(-2.70)	-0.030*	(-1.74)
Dollar Volume _t	0.153**	(2.05)	0.155**	(2.21)
Adj-RSq. (%)	27.20		28.26	

Table 4
Convertible Bond Issuance Patterns During 2008

This table presents summary statistics of weekly convertible bond issuance during the calendar year 2008. *\$CB Proceeds* are the dollar value of all convertible bond issues (\$Million). *\$CB Proceeds/Week* are the average dollar value of weekly convertible bond issuance during the period of interest. *#CB issues* are the number of convertible bond issues by firms in the sample. *Fraction Zero CB Issuance Weeks* is the number of weeks with zero convertible bond issuance divided by the number of weeks in the sub-period. *Total Proceeds* is the dollar value of all convertible, straight debt, and equity issues in the Securities Data Corporation New Issues database. *Straight Junk and Unrated Proceeds* is the issuance of all straight debt in the Securities Data Corporation New Issues database without an investment grade rating.

Panel A provides summary statistics for all firms; Panel B gives summary statistics for financial firms only. Panel C gives summary statistics for firms affected by the September-October ban. Troubled Asset Relief Program (TARP) allocations are given in Panel D. TARP allocations are as reported in: United States Department of the Treasury, January 6, 2009, "Section 105(a) Troubled Assets Relief Program Report to Congress." Weeks are from Sunday through Saturday. Based on this definition, there are 53 weeks in 2008, with Week 0 beginning Tuesday, January 1 and ending Saturday, January 5.

Relevant Date Ranges and Short Selling Policies:

- (1) July 15: SEC emergency order increasing restrictions on naked shorting in 19 financial stocks, beginning July 21. Expired Aug 12.
- (2) September 19: SEC announces short selling ban for 799 stocks, effective immediately. Ban expired October 9.
- (3) October 14: Troubled Assets Relief Program (TARP). Equity infusions in first group of banks began October 28.

	Full Year					Sub-Periods				
	Jan 1-Dec 31	Jan 1-Jul 19	Jul 20-Aug 9	Aug 10-Sept 20	Sept 21-Oct 11	Oct 12-Dec 31				
Number of Weeks	53	29	3	6	3	12				
Panel A: All Firms										
\$ CB Proceeds (\$M)	\$33,553	\$27,383	\$2,993	\$2,061	\$60	\$1,057				
\$ CB Proceeds/Week	\$633	\$944	\$998	\$343	\$20	\$88				
# CB Issues	107	80	8	10	1	8				
# CB Issues/Week	2.02	2.76	2.67	1.67	0.33	0.67				
CB Proceeds/Total Proceeds	3.19%	3.26%	5.57%	4.94%	0.11%	1.73%				
Fraction Zero CB Issuance Weeks	24.53%	10.34%	0.00%	16.67%	66.67%	58.33%				
\$ Straight Junk and Unrated Proceeds (\$M)	\$509,863	\$458,984	\$24,477	\$21,863	\$429	\$4,110				
\$ Straight Junk and Unrated Proceeds/Week	\$9,620	\$15,827	\$8,159	\$3,644	\$143	\$343				
# Straight Junk and Unrated Issues	3,033	2,805	106	92	8	22				
# Straight Junk and Unrated Issues/Week	57.23	96.72	35.33	15.33	2.67	1.8				
\$ Total Proceeds (\$M)	\$1,052,500	\$841,001	\$53,695	\$41,700	\$54,937	\$61,167				
\$ Total Proceeds/Week	\$19,858	\$29,000	\$17,898	\$6,950	\$18,312	\$5,097				
# Total Issues	3,994	3,481	165	158	64	126				
# Total Issues/Week	75.36	120.03	55.00	26.33	21.33	10.5				

Table 4 (Cont'd)

	Full Year		Sub-Periods					
	Jan 1-Dec 31	Jan 1-Jul 19	Jul 20-Aug 9	Aug 10-Sept 20	Sept 21-Oct 11	Oct 12-Dec 31		
Number of Weeks	53	29	3	6	3	12		
Panel B: Financial Firms								
\$ CB Proceeds (\$M)	\$13,475	\$12,265	\$900	\$250	\$60	\$0		
\$ CB Proceeds/Week	\$254	\$423	\$300	\$42	\$20	\$0		
# CB Issues	19	15	2	1	1	0		
# CB Issues/Week	0.36	0.52	0.67	0.17	0.33	0.00		
Convert Proceeds/Total Proceeds	1.75%	1.86%	2.47%	1.03%	0.17%	0.00%		
Fraction Zero CB Issuance Weeks	67.92%	51.72%	66.67%	83.33%	66.67%	100.00%		
\$ Straight Junk and Unrated Proceeds (\$M)	\$469,096	\$429,117	\$21,524	\$17,297	\$0	\$1,159		
\$ Straight Junk and Unrated Proceeds/Week	\$8,851	\$14,797	\$7,175	\$2,883	\$0	\$97		
\$ Total Proceeds (\$M)	\$768,415	\$659,030	\$36,421	\$24,242	\$34,687	\$14,035		
\$ Total Proceeds/Week	\$14,498	\$22,725	\$12,140	\$4,040	\$11,562	\$1,170		
Panel C: Firms Affected by the Ban								
\$ CB Proceeds (\$M)	\$13,160	\$11,250	\$1,600	\$250	\$60	\$0		
\$ CB Proceeds/Week	\$248	\$388	\$533	\$42	\$20	\$0		
# CB Issues	16	11	3	1	1	0		
# CB Issues/Week	0.30	0.38	1.00	0.17	0.33	0.00		
CB Proceeds/Total Proceeds	1.75%	1.77%	4.47%	1.08%	0.14%	0.00%		
Fraction Zero CB Issuance Weeks	71.70%	62.07%	33.33%	83.33%	66.67%	100.00%		
\$ Straight Junk and Unrated Proceeds (\$M)	\$467,608	\$427,116	\$21,459	\$17,875	\$0	\$1,159		
\$ Straight Junk and Unrated Proceeds/Week	\$8,823	\$14,728	\$7,153	\$2,979	\$0	\$97		
\$ Total Proceeds (\$M)	\$751,767	\$636,475	\$35,773	\$23,158	\$43,360	\$13,001		
\$ Total Proceeds/Week	\$14,184	\$21,947	\$11,924	\$3,860	\$14,453	\$1,083		
Panel D: TARP								
TARP Allocations	\$0	\$0	\$0	\$0	\$0	\$227,614		
TARP Allocations/Week	\$0	\$0	\$0	\$0	\$0	\$18,968		

Table 5
Supply Shock Analysis: Impact of Short Sales Restrictions on Convertible Bond Issuance

This table presents results of a regression of weekly convertible bond issuance on contemporaneous issuance of straight debt and equity, as well as dummy variables indicating short sales restrictions. The analysis is based on data from January 1 through October 11, 2008. The dependent variable is *Convertible Proceeds*, the (log) sum of all proceeds of convertible bonds issued in the current week.

Explanatory variables are: *Other Proceeds*, the (log) sum of all proceeds of equity and straight debt issued in the current week; *Fin19*, a dummy variable equal to one if the U. S. Securities and Exchange Commission's (S.E.C.'s) order increasing restrictions on naked short selling in 19 financial stocks is in effect during week *t* (July 20-Aug 9); *ShortBan*, a dummy variable equal to one if the S.E.C.'s ban on short selling in 799 stocks is in effect during week *t* (Sept 21-Oct. 11); *Straight Junk and Unrated Proceeds*, the (log) sum of all non-investment grade straight bond issuance; and *BAA-AAA Spread*, the difference between Moody's seasoned corporate BAA and AAA bond yields. Weeks are from Sunday through Saturday. Week 0 begins Tuesday, January 1. Panel A presents regression results for all firms in the sample. Panel B presents results for financial firms (SIC Codes 6000-6999) only.

Newey-West adjusted t-statistics are in parentheses. *, **, and *** denote 10%, 5% and 1% significance, respectively.

	Model 1		Model 2		Model 3		Model 4	
Panel A: All Firms	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
VERTIBLE PROCEEDS								
Intercept	-2.252	(-0.42)	-7.039	(-1.11)	-3.242	(-0.58)	-14.452	(-1.27)
Other Proceeds _t	1.665***	(3.32)	0.886*	(1.95)	1.800***	(3.30)	1.171*	(1.95)
Fin19 _t	0.882*	(1.81)	0.616	(0.75)	1.042**	(2.09)	0.478	(0.57)
ShortBan _t	-9.360***	(-6.63)	-5.255**	(-2.50)	-9.556***	(-4.99)	-5.908**	(-2.23)
Straight Junk and Unrated Proceeds _t	-0.927***	(-4.31)			-1.086***	(-3.72)		
BAA-AAA Spread _t			2.824	(0.64)			5.675	(0.98)
Convertible Proceeds _{t-1}			0.188	(1.48)	0.109	(0.73)		
Adj-RSq. (%)	26.13		18.68		27.98		19.63	
Panel B: Financial Firms								
VERTIBLE PROCEEDS								
Intercept	-10.298**	(-2.34)	-12.982	(-1.61)	-9.155*	(-1.78)	-10.561	(-0.91)
Other Proceeds _t	2.136***	(3.13)	1.075**	(2.05)	1.957**	(2.44)	0.868	(1.33)
Fin19 _t	-1.053	(-1.01)	-1.765	(-1.38)	-0.982	(-0.91)	-1.569	(-1.22)
ShortBan _t	-7.114**	(-2.19)	-2.297	(-1.01)	-6.846**	(-2.06)	-2.117	(-0.85)
Straight Junk and Unrated Proceeds _t	-0.815**	(-2.48)			-0.777**	(-2.21)		
BAA-AAA Spread _t			4.076	(0.91)			3.491	(0.60)
Convertible Proceeds _{t-1}			0.089	(0.54)	0.135	(0.79)		
Adj-RSq. (%)	15.59		5.39		12.15		2.41	

Figure 1
Convertible Bond Proceeds and Capital Supply Variables

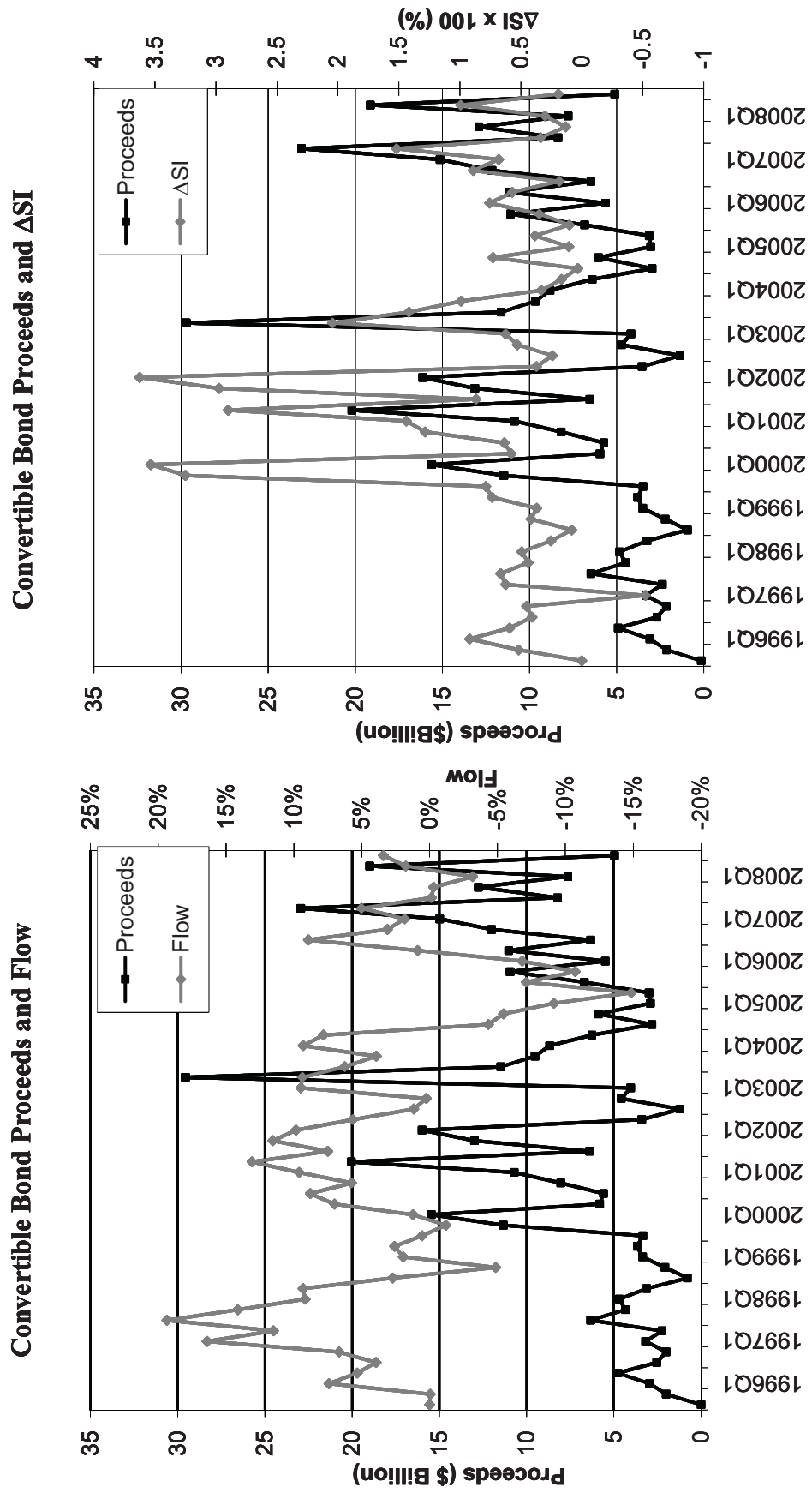


Figure 2
Convertible Bond Quantities and Underpricing

