

A Liquidity-Based Explanation of Convertible Arbitrage Alphas

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Abstract: We examine the extent to which excess returns from convertible arbitrage represent positive returns to managers to exploiting pricing inefficiencies versus compensation for exposure to systematic risk factors. Initial empirical tests show that when we exclude liquidity risk as a factor, a good portion of abnormal returns to convertible bond strategies appears to be driven both by overpricing of the underlying equity and apparent underpricing of convertible bonds. However, when we include the effects of liquidity, abnormal returns to convertible bond arbitrage essentially disappear and only remain localized in convertible debt trading closer to the issuance date.

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A Liquidity-Based Explanation of Convertible Arbitrage Alphas

The hedge fund industry has experienced a tremendous roller coaster ride over the last 15 years, having grown from less than \$100 billion in assets under management (AUM) in 1994 to over \$2 trillion by the Summer of 2008 and then down to around \$1 trillion by the Summer of 2009.¹ One of the reasons for the sudden downswing in AUM has been a re-thinking by investors as to what risk exposures are really being taken by hedge funds and how much of the return that hedge funds generate are merely fair compensation for these risk exposures versus alpha. There is no better setting to analyze this issue of systematic risk compensation versus alpha than convertible arbitrage, one of the oldest investment strategies employed by the hedge fund industry. It has long been advertised that convertible managers seek to capture riskless returns by exploiting relative pricing inefficiencies in a firm's convertible debt and equity by taking long and short positions in these securities – typically long convertible debt and short common equity. As one of the oldest and, at times, most widely employed hedge fund strategies, the basic principles of convertible arbitrage have been publicly known for quite some time. However, the magnitude and persistence of this strategy's performance over the years presents a puzzle in finance.² If transaction costs are low, and assuming a relative abundance of human and financial

¹ Based on industry data reported by Barclay Trading Group Ltd., available at http://www.barclaygrp.com/indices/ghs/mum/HF_Money_Under_Management.html. Excludes investments in Fund of Funds category. Also see Santini et al. (2007).

² Liang (2001) provides returns characteristics for convertible arbitrage and other hedge fund strategies for the 1990-1999 period. Using more recent data and for the 1988-2003 period, Malkiel and Saha (2005) report a 15.9% annual return for the Van Global Hedge Fund Index, compared to 12.3% for S&P 500 index during the same period. We later present excess return results from replications of the convertible arbitrage strategy. Fabozzi, Liu, and Switzer (2009) replicate convertible arbitrage strategies, finding large absolute and relative returns that are robust to different specifications of transaction costs, leverage effects, and alternative parameter inputs.

capital to be devoted to the strategy, the abnormal returns earned by convertible arbitrage funds in their early history should have quickly disappeared over time.

Another common explanation for the strategy's historical performance is that the call option embedded in a convertible bond is underpriced and, therefore, by taking a long position in a convertible bond and hedging residual risks, convertible arbitrage essentially isolates and takes a long position in this underpriced call option. However, after the second half of 2008, this explanation also seems puzzling. During September and October, the implied volatility of options as represented by the VIX shot up from just under 20% to over 80%. Any strategy that was long an option should have experienced tremendous positive performance. Instead September and October of 2008 turned out to be the worst two months ever for convertible arbitrage, posting returns of -12% and -13%, respectively – deepening the puzzle about explaining the strategy's returns.³ Hence the strategy's continued and large-scale use by hedge fund managers and investors calls for exploring alternative risk-based or pricing-based explanations for the returns produced by the strategy.

In this paper, we assess whether these return patterns can be explained by convertible arbitrageurs' exposures to liquidity risk, which we argue arises not only from holding a long position in illiquid convertible debt securities, but also from diminished liquidity in the *equity* markets of convertible debt issuers, at least after the initial issuance period. The latter rather surprising result, we suggest, arises from equity investors' reduced willingness to transact in securities of firms with more complex capital structures, as induced by the introduction of difficult-to-value convertible debt securities. Empirical tests confirm that any seeming abnormal returns to convertible arbitrage represent compensation for greater exposure to liquidity risk,

³ These are the returns posted by the CSFB Tremont Convertible Arbitrage index.

The role of liquidity risk

Convertible arbitrage involves a hedging strategy of forming portfolios that are long corporate bonds and short equities in such a way as to be market neutral. While this long-short position appears to reduce risk, this strategy in fact greatly increases the proportion of liquidity risk in the portfolio and magnifies (with leverage) the quantity of liquidity risk.⁴ The liquidity risk in the strategy comes about from the fact that corporate bonds are typically several orders of magnitude more illiquid than equities.⁵ Hence the long and short positions are grossly mismatched on the dimension of liquidity risk. This liquidity mismatch in the portfolio gives rise to a long exposure to liquidity risk, which cannot be hedged. Therefore, convertible arbitrage funds – and in fact, virtually all funds with long-short positions where the long and short positions are not carefully matched on liquidity risk – end up bearing considerable liquidity risk in their portfolios. Any risk-adjusted performance evaluation tests that fail to account for this liquidity risk will mistakenly assess abnormal positive returns as a return to the superior skill of fund managers. As such, our basic hypothesis is that any seeming excess returns to investors of convertible arbitrage merely represent fair compensation for liquidity risk and will disappear when an adequate adjustment is made for exposure to systematic liquidity risk factors.

Less obviously, we also posit that even the simpler parts of firms' capital structures may suffer from heightened exposure to liquidity risk upon the introduction of a complex, hybrid

⁴ Liquidity generally refers to an investor's ability to buy/sell a security at close to its fundamental value. When markets are perfectly liquid, an investor can transact in any security at fundamental value. When markets are illiquid, a bid-ask charge is imposed on an investor and causes the transaction price to deviate from fundamental value. The more illiquid the market, the greater this deviation from fundamental value (for a given quantity of securities and a given demand for transaction immediacy). Liquidity *risk* refers to the fact that the illiquidity level varies through time, rendering the investor uncertain as to the price deviation from fundamental value that he will experience whenever he chooses to transact in the security.

⁵ See, for example, Edwards, Harris, and Piwowar (2007).

security like convertible debt. To the extent that understanding the valuation consequences of convertible debt on the value of a firm's equity is a difficult task requiring research and proper training, investors can be seen as having to pay a fixed cost to properly participate in this market.⁶ Huang and Wang (2009), building on Allen and Gale (1984), create a model in which these fixed participation costs reduce the pool of available counterparties and thus increase the liquidity risk of traded securities. Because investors may be deterred from trading in their now more difficult-to-value securities affected by the debt's conversion option, we predict that the equity of convertible issuers will consequently suffer exposure to liquidity risk. We also predict that the liquidity risk will be increasing in the proportion of firms' capital structures that is composed of convertible debt, given the heightened consequences of valuation errors for equity in these circumstances.⁷

Consistent with these explanations, the empirical tests we conduct below show reliably negative returns to investors in the equity markets of convertible issuers in tests excluding a liquidity risk factor proxy, but that abnormal returns disappear once this factor is included in time-series regression tests. Moreover, in replications of convertible arbitrage strategies, any

⁶ In building their equity valuation models, investors need to estimate the probability of exercise at different points in time to assess future interest payments, the likelihood of bankruptcy (which affects the value of equity's abandonment option in valuation models), and the extent of equity dilution subsequent to conversion. All of these tasks require both effort and a sophisticated understanding of optimal exercise policies and convertible debt valuation.

⁷ Huang and Wang (2009) create a model in which costly market participation generates endogenous order imbalances even in the presence of perfectly matching trading needs. In their model, purely idiosyncratic shocks can generate aggregate liquidity needs that cause prices to deviate from fundamental value, as large numbers of traders with liquidity shocks in the same direction as movements in an aggregate risk factor cannot easily find counterparties to offset their exposure to the aggregate risk factor. In order for the market to clear with participation costs, prices must fall even further away from fundamental value. Additionally, as participation costs increase, traders are even further exposed to the risk that selling prices may deviate from fundamental value.

positive hedge portfolio abnormal returns that appear to be generated by the complexity of firms' capital structures disappear once a liquidity risk factor proxy is included. However, there do appear to be some abnormal returns generated closer to convertible bonds' issuance dates for convertible arbitrage strategies.⁸

The layout of the remainder of this paper is as follows. In the next section, we describe the research design, including summary statistics, construction of our empirical proxies, and details of our testing strategy. The third section then presents testing results, while the last section provides a summary of our results and concluding remarks.

METHODOLOGY

Data Description

Weekly data on bond prices, market values, issue amounts, and issue dates for 1992 to October 2003 were obtained from Datastream. Datastream lists the issue amount and date, though bond prices are typically absent from the database before January 1996. Datastream does not have identifiers linked to CRSP and Compustat, so bonds were matched to CRSP and Compustat manually based on the name of the borrower. In cases where borrowers are subsidiaries of firms with traded equity, we traced the subsidiary to an ultimate parent using Thompson Research's Corporate Information database. To be included in sample, firms must

⁸ Choi, Getmansky, and Tookes (2009) find evidence consistent with a scenario in which convertible arbitrageurs' trading activities after convertible bond issuance promote *improvements* in liquidity in the equity markets of issuers, at least in the six-month post-issuance window they explore in their paper. Our results are not inconsistent with Choi, et al.'s, as we explore abnormal returns for convertible bonds and equities *throughout* a convertible bond's life, and not just in the three-month post-issuance holding period for convertible bonds that the typical hedge fund manager adopts (Kostigen (2006)). Arbitrageurs' activities in trading against net market demand, which may temporarily reduce the likelihood of order imbalances and improve liquidity in the equity markets of convertible issuers, will be concentrated within the six-month post-issuance period that Choi, et al., explore in their paper.

have either plain or convertible bonds outstanding (as identified in Datastream), have equity price data available in CRSP, and have financial information available in Compustat. All firm-weeks with equity prices less than \$5 are excluded from the sample, consistent with prior literature utilizing time-series multifactor regressions. Given the relatively infrequent trading of corporate bonds, which compels some week-to-week bond values to vary widely, we exclude from the analysis the upper and lower 1.5% of bond returns. We match bond returns to weekly asset pricing factor changes, obtained from Kenneth French's website (for stock market factors) and Datastream (for bond market factors). We obtain data on three-month Treasury bill rates from the Board of Governors of the Federal Reserve, available each business day.

Descriptive and summary statistics for our sample bonds are listed in Exhibit 1.

Convertible bonds tend to be issued in larger amounts relative to plain bonds, with a mean issue amount of \$233.5 million in the pre-1997 period and \$462.8 million in the January 1997-October 2003 period, compared to a mean issue amount of \$185.8 million pre-1997 and \$332.6 million in the later period for plain bonds. Summary statistics for the sample firms are listed in Exhibit 2. Firm-quarters and firm-days are classified as "complex" if the borrower has any convertible debt outstanding at that point as of fiscal quarter end dates for financial data or as of trading dates for market data; firms are classified as "simple" if the firm only has plain debt outstanding as of either of these dates. For the 1992-1996 period, complex firms have a mean asset amount of \$4.2 billion, compared to the mean asset value of \$17.4 billion for simple firms; for the 1997-2003 period, the numbers are \$10.4 billion for complex and \$18.4 for simple firms. Finally, especially in the post-1996 period, complex firms have significantly greater market-to-book ratios. This is perhaps not surprising, given that the types of firms who optimally choose to use convertible bonds are those needing to overcome informational problems and control

overinvestment incentives due to the existence of investment options; firms with high market-to-book ratios will have more of their value locked in unrecorded assets, like intangible assets or growth options, whose true value cannot easily and reliably be conveyed to investors.

The industry breakdown of the sample firms shown in Exhibit 3 suggests that all industry sectors saw an increase in the users of convertible debt between the two periods, though no clear pattern emerges in terms of the specific industries using these instruments. Exhibit 4 lists cumulative buy-and-hold returns (on a log scale) for the value-weighted portfolios of the equity and issue-weighted portfolios of plain and convertible bonds for all sample firms. Portfolios are rebalanced weekly as firms meet criteria for inclusion and exclusion in the data sample. We also include an equal investment in treasury-bills, from January 1992 to October 2003. As expected, convertible debt returns represent an intermediate position between plain corporate bonds and equity returns.

Complexity Metric and Rankings

Our hypotheses tests require assessing whether liquidity risk is increasing in the extent to which a firm's capital structure is composed of hybrid securities, so the first requirement is to build a metric of capital structure complexity. We define capital structure complexity as the ratio of market value of outstanding convertible debt to the sum of the total market value of the firm's outstanding convertible bonds, plain bonds, and equity. Where market value is not available from Datastream, we substitute the market value with the issue amount of the bond. To test whether primary convertible bond market participants might earn excess returns largely from the

original issue discount in these securities, we also utilize a capital structure complexity metric that weights firm's convertible bond values by the number of years until the bond's maturity.⁹

Exhibit 5 lists summary statistic for our capital structure complexity metric. Untabulated statistics suggest no material differences between the two subperiods, so we only list average results for the entire 1992-2003 sample period. Typically, around a quarter of firms in the sample have some convertible debt outstanding, as exhibited by the number of firms registered greater than zero on this metric relative to the number of firms that are in the sample. For firms with convertible debt, an average of 13.7% of firms' capital structure is composed of convertible debt, while the weighted capital structure metric registers an average level of 38.3%.¹⁰

Testing Strategy

We run several complementary tests to assess the impact of capital structure complexity and illiquidity on the valuation of firms' capital structures. Our first set of tests search for the existence of abnormal returns in portfolios involving the equity of firms with convertible bonds in their capital structure on a constant and various configurations of asset pricing factors. Next,

⁹ Where bonds have multiple maturity dates, we use the first maturity date to calculate time to maturity.

¹⁰ One drawback of our complexity measure is that it will tend to overstate the actual portion of firms' capital structure that is composed by convertible debt. This is because, while Datastream claims to offer extensive coverage of firms' outstanding debt issues, the possibility exists that some debt issues will be missing from the denominator of the metric, which overstate the complexity metric. Additionally, Datastream only offers *public* debt issues; the value of firms' bank debt will be missing from the denominator of this metric, again causing overstatement of the metric. We have no reason to believe that there is anything systematic about the types of firms Datastream chooses to cover, so this may just result in measurement error on our sort. Additionally, it is possible that firms with a greater portion of bank debt in their capital structure also share traits that cause systematic over- or under-pricing—or differences in exposure to liquidity risk—of firms' equity. However, we are aware of no theory that would predict these effects due to the existence of more or less bank debt in a firm's capital structure.

to assess whether any (seemingly) abnormal returns generated from positions in the equity of firms with convertible debt result from compensation for bearing risk that is not captured in our risk models, we also run hedge portfolios going long in the equity of firms with convertible debt and investing an equal dollar amount in a short position in the equity of firms without convertible debt in their capital structure. The number of firms without convertible bonds is selected to equal the number with outstanding convertible bonds each week, and firms are selected randomly from the population of firms with only plain bonds in their capital structures.

In additional tests, we go long in issue-amount-weighted portfolios of all convertible bonds for all convertible bonds in our sample. To then replicate actual convertible arbitrage strategies that seek to mitigate the impact of market fluctuations on the hedge strategy, we run tests adopting an offsetting short position in the equity of firms with convertible debt in their capital structure. To mitigate exposure to fluctuations in the broad equity market, we adjust the ratio of investments in convertible bonds and investments in equities. This “hedge ratio” is estimated from the ratio of the coefficient estimate on the market factor for the convertible bond and equity portfolios, in regressions using the three Fama-French factors¹¹. Given that the convertible bond is a debt-equity hybrid, we would expect its exposure to the market factor will be much less than the pure equity portfolio’s exposure, so that the hedge ratio should be greater than one.¹²

In addition to the basic tests for the existence of abnormal returns on portfolios of firms with and without convertible debt, we also run additional tests on portfolios of firms sorted by the complexity metric described above. Each week, firms in the sample are sorted on both the

¹¹ Fama and French (1992). Results are similar when the hedge ratio is derived from regressions of portfolios on the market factor alone.

¹² Consistent with this, later regression results suggest that a five-to-one (or higher) convertible bond-to-equity hedge ratio largely eliminates exposure to the market factor.

weighted-by-time-to-maturity complexity metric as well as the unweighted metric. We then form portfolios of securities for those firms lying in the upper and lower quartile of the metric, and run multifactor asset pricing tests as described above.

Thus, the three types of firms used in portfolio tests (rebalanced weekly) are:

1. All Convertibles-Equity of firms with any outstanding convertible debt in their capital structures at the beginning of each week
2. High Complexity-Equity of firms rating in the highest quartile of the complexity metric at the beginning of each week
3. Weighted High Complexity-Equity of firms rating in the highest quartile of the weighted complexity metric at the beginning of each week

The asset pricing factors we use (in various configurations) in our tests include the three Fama-French factors: (i) $R_m - R_f$, the weekly value-weighted returns for NYSE, AMEX, and NASDAQ stocks (available from CRSP) less a weekly risk-free rate imputed from the latest available three-month Treasury bill rate available from the Federal Reserve bank each business day, (ii) the size factor (SMB), and (iii) the book-to-market factor (HML). Additionally, we include a momentum factor (UMD), given the possibility that the momentum effect documented in Jegadeesh and Titman (1993) is driving our results.

In tests involving convertible bond returns, we also include the bond market pricing factors established by Fama and French (1993). One factor measures shifts in economic conditions that change the likelihood of default (DEF), which we proxy for using the weekly change in the Merrill Lynch Corporate Bond Master Index less the change weekly long-term government bond return index (from a proprietary Datastream index). Another factor involves tracking unexpected changes in interest rates (TERM), which we proxy for using the percent

changes in the weekly long-term government bond return index less one week's accrued interest on the most recent available three-month Treasury bill rate available at the beginning of each portfolio week.

Lastly, in separate tests, we also include a factor representing the level of aggregate market liquidity. The results of Longstaff, Mithal, and Neis (2005) and Collin-Dufresne, Goldstein, and Martin (2001) both suggest that a significant portion of the yield spread on corporate bonds is due to a liquidity premium on bonds. As aggregate market liquidity decreases, the ability of corporate bondholders to liquidate their positions at a price close to fundamental value should also correspondingly decrease. As a test of this proposition, we also run tests including the log of the average of that week's NYSE share trading volume (in hundreds of millions of dollars). While we expect abnormal return estimates to be decreasing when this factor is included, as positive abnormal returns represent compensation for bearing liquidity risk, the impact of this factor on hedge portfolios will depend on the relative magnitude of any liquidity premia in the long and short portfolios, as well as the hedge ratio between dollars invested in long and short portfolios.

EMPIRICAL RESULTS

Basic tests

Exhibit 6 represents estimates of one-, two-, four-, and six-factor time-series regressions of (a) portfolios going long in the equity of firms with varying amounts of convertible bonds in their capital structure, (b) portfolios going long in the equity of firms without convertible bonds, with the number of firms in each non-convertible-issuer portfolio matching the number of firms in each convertible-issuer portfolio, and (c) hedge portfolios going long in the equity of firms

with varying levels of convertible debt in their capital structure and short the equity of firms with no convertible bonds. Estimates reveal that abnormal returns for value-weighted portfolios going long the equity of convertible-issuing firms are uniformly negative. Average annualized risk-adjusted portfolio returns for firms with some convertible debt in their capital structures (Complex) were -3.61%; for firms in the upper quartile (UQ) of the capital structure complexity metric described in section II.b. above, abnormal returns fall to -4.30%; and for firms in the upper quartile of the weighted (by time-to-maturity) capital structure complexity metric (WUQ), abnormal returns fall to -4.54%.¹³

Interestingly, in light of summary statistics in Exhibit 2 regarding the relative size of convertible bond issuers, Complex firms have little exposure to the size (SMB) factor. However, the exposure increases as we move to the UQ and WUQ portfolios; firms for which convertible debt composes a very large portion of capital structure likely are very small firms that have very little debt capital other than the convertible bond. However, as expected, equity portfolios of firms without convertible bonds enjoyed zero abnormal returns.

Results are even stronger, and return patterns are similar, when we offset these long positions in the equity of firms with convertible debt with short positions in firms without convertible debt. Hedge returns with Complex firm portfolios are -3.99% (though the statistical significance is diminished when the momentum factor is included); with UQ firms, hedge returns are -5.38%; and for WUQ firms, hedge returns are -6.20%. These results showing equity valuation effects in firms issuing convertible debt is striking, and has not been previously rigorously documented elsewhere. Consistent with our initial hypothesis, returns on all equity

¹³ Abnormal returns are mitigated when the momentum factor (UMD) is included in tests, but results remain economically and statistically significant at conventional levels (except for the WUQ portfolio firms).

portfolios are reliably negative. However, we do not find reliable support for our hypotheses on the link between the *degree* of capital structure complexity—as a driver of participation costs in the market—and abnormal returns; in untabulated tests, we find no statistically reliable difference between returns in the Complex and UQ portfolios, or between the Complex and WUQ portfolios.¹⁴ The mere presence of convertible debt in a firm’s capital structure appears to be enough to generate negative returns to equityholders, which we suggest results from diminished participation in the market for an issuer’s equity.

Our ultimate aim, however, is to replicate actual convertible arbitrage strategies by going long convertible debt and short the underlying equity security. To put these later results in context, we first examine return patterns for Exhibit 7 shows returns in portfolios only going long in convertible bond portfolios, with various regression configurations of stock- and bond-market risk factor proxies. Results show that all returns are positive and statistically significant, and returns vary far more strongly with equity, rather than debt, risk factor proxies for all portfolios; the adjusted- R^2 is a little over 1% for the All Convertibles portfolio regressed on the DEF and TERM factors, but jumps to over 55% in the model only including the equity market factor $R_m - R_f$. We have no expectations regarding abnormal returns for convertible bonds in the High Complexity (for firms rated in the upper quartile of on our complexity metric at the beginning of each portfolio formation week) relative to the All Convertibles portfolio, but we do see a slight decrease in abnormal returns: Averaging abnormal returns across all risk models, we

¹⁴ To test for abnormal return differences, we perform two complementary tests. First, we include returns on the Complex portfolio in factor regressions for the UQ and WUQ portfolios, which allows us to control for the common portion of return variation in excess of that explained by risk factors, which is important as the Complex and both UQ and WUQ portfolios contain many of the same firms. Second, we run multifactor asset pricing regressions in differences between each portfolio; doing so is similar to going long securities in the Complex portfolio and short securities in the UQ and WUQ portfolios. Constant estimates in all of these regressions are statistically insignificant at conventional levels.

find annualized returns going from 3.6% in the All Convertibles portfolio, to 3.1% for the High Complexity portfolio.

More strikingly, the Weighted High Complexity portfolio—where bonds nearest to issuance date are more likely to be housed—has the lowest abnormal returns, at 2.6%. Given our hypotheses, this result is perhaps unsurprising, as trading volume in markets for convertible bonds is highest closer to issuance date. As a result, we would expect a lower liquidity premium at this stage in the bond's life, and asset pricing tests excluding a liquidity risk factor should show higher returns for bonds closer to maturity, as compensation for increased liquidity risk exposure. However, reflecting our abnormal return tests for equity portfolios, in untabulated tests, we find no statistically reliable differences between the All Convertibles and both the High Complexity and Weighted High Complexity portfolios.

Results in Exhibit 8 show abnormal returns for our main replication tests. Hedge portfolios going long convertible bonds and short the equity of firms with convertible bonds (Hedge-All Convertibles) are positive and significant, with abnormal returns averaged across all risk models at an annualized level of 4.0%. Mirroring the pattern in tests of long convertible bond portfolio returns, average abnormal returns for both the Weighted and Unweighted High Complexity portfolios are lower than returns for the all convertible bond portfolio: High Complexity abnormal portfolio returns are at 3.5%, while those for the Weighted High Complexity are at 2.8%. Return patterns among the three sets of equity portfolios listed in Exhibit 6 would suggest that the short position of the hedge portfolios might mitigate this decreasing pattern, as returns to equity portfolios become increasingly more negative as we move from Complex, to High Complexity, to Weighted High Complexity portfolios. However, the five-to-one (or seven-point-three-to-one for the Weighted High Complexity portfolio)

convertible bond-to-equity hedge ratio we maintain to manage exposure to equity market movements likely diminishes the abnormal return impact of the hedge portfolio's short equity leg. In any event, we again find no reliable differences in abnormal returns across the various portfolios.

In summary, multifactor asset pricing tests reveal the surprising result of negative risk-adjusted returns in the equity of firms issuing convertible debt, with the magnitude of abnormal returns increasing in the extent to which capital structure is composed of convertible debt. Further tests show positive abnormal returns to convertible bond portfolios, with returns smaller (though not statistically significantly so) for bonds closer to their issuance date. Tests designed to replicate convertible bond strategies by going long convertible debt and shorting the equity of firms with convertible debt show a similar return pattern to the long convertible bond portfolio tests. In the next section, we assess whether these results, suggestive of mispricing in convertible bonds and the equity of convertible issuers, can be explained as securityholders' compensation for bearing liquidity risk.

Tests including liquidity factor

Results in Exhibit 9, where tests on equity portfolio returns now include a liquidity risk factor proxy, tell quite different story from the initial results presented in Exhibit 6. Abnormal return tests show that the statistical significance of negative abnormal returns to the equity of firms with convertible bonds is eliminated, once we test for greater exposure to liquidity risk. As we propose above, this may result from the fact that the issuance of convertible debt may hamper liquidity in the market for a firm's equity. Costs associated with estimating the potential dilutive

impact of convertible debt may prevent some investors from participating in the market, reducing the number of potential purchasers and thus increasing equityholders' exposure to liquidity risk.

As a companion to Exhibit 7, Exhibit 10 shows multifactor asset pricing tests for long convertible bond-only portfolios. Returns to All Convertible and High Complexity portfolios are insignificant, though abnormal returns to the time-to-maturity-Weighted High Complexity portfolios remain statistically significant, ranging from 3.8% to 6.5%. Results suggest that most of what would appear to be abnormal returns accruing to convertible bond holders are largely related to compensation for bearing liquidity risk, which is unsurprising in a market as illiquid as that for convertible bonds. Any abnormal returns to holders of these hybrid securities appear only to occur in the early part of the convertible's life. At this stage of maturity, trading is unusually heavy, mitigating the impact of liquidity risk, and primary market buyers likely benefit from original issue discount corporate borrowers offer on these securities (see Chacko, Jurek, and Stafford (2008)).

Exhibit 11 shows results for our main long convertible bond/short equity portfolio tests, now including the liquidity proxy. Similar to long-only convertible bond tests, abnormal return estimates are only significant for firms in the time-to-maturity Weighted High Complexity portfolio, with annualized abnormal returns ranging from 4.3% to 4.8%. This reinforces the notion that any abnormal profits from convertible arbitrage are concentrated in convertible bonds closer to their issuance date.

Significantly, and in contrast to tests excluding the liquidity risk factor proxy, we find statistically reliable differences in untabulated tests between returns to the time-to-maturity Weighted High Complexity and all other portfolios, for almost all configurations of asset pricing factors. The constant estimate in regressions of a) weekly return differences between the Hedge-

Weighted High Complexity and either the Hedge-All Convertibles or Hedge-High Complexity portfolios and b) the Hedge-Weighted High Complexity portfolio returns on risk factors and either the Hedge-All Convertibles or Hedge-High Complexity portfolio returns are positive and statistically significant, for all risk factor configurations.

In summary, in tests excluding the liquidity factor, we find that a good portion of abnormal returns to convertible arbitrage strategies appears to be driven both by overpricing of the underlying equity and apparent underpricing of convertible debt, with abnormal returns to portfolios going long convertible bonds and short the equity of firms issuing convertible bonds actually decreasing as the size of issues as a portion of total capital structure increases and as firms are closer in time to convertible bond issuance dates. When we consider the effects of liquidity, however, we find that all abnormal returns to holders of issuing firms' equity disappear once we account for their increased exposure to liquidity risk. Additionally, any abnormal returns to convertible arbitrage are localized in convertible bonds trading closer to the issuance date, consistent with results of prior literature in which one of the chief sources of convertible arbitrage's profitability is in primary market buyers' exploitation of issuers' typical discounting of these securities.

CONCLUSION

The results of our study indicate that—except for near-to-issuance-date convertible bonds—convertible arbitrage managers are not capitalizing on pricing inefficiencies in the convertible debt of issuers, but are instead being compensated for exposure to liquidity risk. More strikingly, we find that the equity market participants of firms with convertible debt suffer

from heightened exposure to liquidity risk, relative to firms with simpler capital structures. The latter result is striking, and to our knowledge not documented elsewhere in the literature.

While many convertible arbitrage funds hedge out risk factors such as interest rate risk and default risk from their portfolios, our replication results indicate that these investors fail to hedge out liquidity risk. This is consistent with a scenario where standard performance evaluation regressions for hedge funds leave out liquidity risk as an explanatory factor in convertible arbitrage returns; as a result, the loading on a liquidity risk factor proxy shows up as a positive alpha in these regressions. When properly accounting for liquidity risk as an independent variable in these regressions, compensation for simply bearing liquidity risk is stripped out of the alpha. We therefore obtain a more accurate picture of the alpha-generation capability of convertible arbitrage, which appears to be concentrated in convertible bonds at their initial issuance. The puzzle behind the persistence of alpha in convertible arbitrage thus seems to be solved: the alpha does not appear to be true alpha but instead merely fair compensation for bearing liquidity risk.

Given this explanation of the alpha puzzle, the question then arises as to whether the fees charged by convertible arbitrage funds as well as other hedge funds employing strategies that entail the bearing of liquidity risk¹⁵ are reasonable. These hedge funds typically charge fees in the range of 2% of AUM and 20% of absolute performance, which are substantially higher than the 10-20 basis points of AUM that are typically charged for an index fund providing passive exposure to a systematic risk factor. However, here it is important to consider that the provision

¹⁵ Several other strategies also take long-short positions where there are obvious liquidity differences between the long and short positions. For example, capital structure arbitrage often involves the purchase of corporate debt and the shorting of equity of a firm. Long-short equity strategies often involve taking a long position that is significantly more illiquid than the short position – funds often explain this discrepancy as due to the increased risk of a “short squeeze,” and potentially needing to liquidate the short position rapidly.

of exposure to liquidity risk is not a passive strategy. It requires careful financial risk measurement and engineering to hedge the systematic risk exposures such as interest rate and credit risk, and thereby deliver a product with a relatively large liquidity risk component. For the skill and work required to deliver such a product, high fees may very well be fair compensation. For institutions with long-dated liabilities, who are best positioned to take advantage of liquidity risk due to their long investment horizons, the benefits of taking liquidity risk, even after accounting for hedge fund fees, can be substantial.

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Exhibit 1
Bond Summary Statistics

	Sample	Mean Maturity (years)	Mean Issued (\$millions)	Median Issued (\$millions)
<i>Issued pre-1997</i>				
Plain bonds	2,979	16.0	185.8	150.0
Convertibles	293	11.2	233.5	100.0
<i>Issued 1997-2003</i>				
Plain bonds	5,776	10.6	332.6	250.0
Convertibles	817	14.1	462.8	300.0

Note: This exhibit shows the mean maturity and mean and median issued amount for all plain vanilla and convertible bonds in the sample. Where firms have a range of maturity dates, the first possible maturity date is used to calculate the mean maturity. Bonds are partitioned based on whether they were issued before or after January 1, 1997. All amounts are winsorized at the 0.5% level.

Exhibit 2
Borrower Summary Statistics

Panel A. Total Assets		Firm-Quarters	Mean	Median	25th%	75th%	SD
<i>1992-1996</i>	Simple	9,170	17,383.3	5,553.0	1,981.9	15,326.7	32,083.9
	Complex	3,683	4,217.5	1,427.0	483.1	4,208.0	7,802.9
<i>1997-2003</i>	Simple	17,864	18,430.3	3,816.8	1,449.2	12,870.6	47,620.5
	Complex	6,130	10,413.8	2,297.4	853.0	6,494.6	33,680.8

Panel B. Market Values		Firm-Days	Mean	Median	25th%	75th%	SD
<i>1992-1996</i>	Simple	124,540	6,267.0	2,631.1	986.7	6,411.0	11,177.1
	Complex	49,627	2,638.3	900.7	270.6	2,836.7	4,912.1
<i>1997-2003</i>	Simple	234,618	9,164.3	2,161.0	712.1	7,129.6	20,914.4
	Complex	81,946	7,328.0	1,958.3	722.1	6,144.3	17,536.3

Panel C. Market-to-Book		Firm-Days	Mean	Median	25th%	75th%	SD
<i>1992-1996</i>	Simple	124,540	1.94	1.52	1.01	2.33	2.76
	Complex	49,627	2.02	1.54	1.06	2.38	3.34
<i>1997-2003</i>	Simple	234,618	2.49	1.73	1.03	2.95	4.54
	Complex	81,946	2.99	1.95	1.19	3.41	5.37

Note: This exhibit shows the summary statistics for sample firms from the CRSP/Compustat Quarterly Merge File, partitioned on the January 1992-December 1996 and the January 1997-October 2003 periods. Panel A lists total assets of all sample firm-quarters. Panel B lists the total market value of equity for all sample firm-days. Panel C lists the market-to-book ratio for all sample firms. Consistent with Fama and French (1992), the book value of common stockholders' equity is computed as the book value of stockholders' equity, plus balance sheet deferred taxes and investment tax credit (if available), less the book value of preferred stock. Depending on availability, we use redemption, liquidation, or par value (in that order) to estimate the book value of preferred stock. All amounts are winsorized at the 0.5% level.

Exhibit 3
Borrower Industry Breakdown

Industries	NAIC Prefix	<i>1992-1996</i>			<i>1997-2003</i>		
		Simple	Complex	% Complex in Industry	Simple	Complex	% Complex in Industry
Agriculture, Forestry, Fishing, and Hunting	11	3	0		3	0	
Mining	21	52	13	20%	44	21	32%
Utilities	33	81	4	5%	71	14	16%
Construction	23	18	4	18%	15	7	32%
Manufacturing	31-33	452	72	14%	364	158	30%
Wholesale Trade	42	39	7	15%	29	17	37%
Retail Trade	44-45	58	13	18%	50	21	30%
Transportation and Warehousing	48-49	41	12	23%	40	13	25%
Information	51	80	15	16%	69	26	27%
Finance and Insurance	52	209	20	9%	197	32	14%
Real Estate and Rental and Leasing	53	12	4	25%	10	6	38%
Professional, Scientific and Technical Services	54	20	5	20%	11	13	54%
Administrative and Support and Waste Management and Remediation Services	56	17	5	23%	17	5	23%
Education Services	61	1	0		1	0	
Health Care and Social Assistance	62	19	9	32%	13	13	50%
Arts, Entertainment, and Recreation	71	8	1	11%	8	1	11%
Accommodation and Food Services	72	24	2	8%	19	7	27%
Other Services	81	3	0		2	1	
	Total	1,137	186	14%	963	355	27%

Note: This exhibit gives a tabulation of sample firms by NAIC-classified industry for the January 1992-December 1996 and the January 1997-October 2003 periods, as listed in the CRSP/Compustat Quarterly Merge File. Firms are classified as “simple” in each period if they at no point during the period have any convertible debt outstanding (as listed in Datastream). Firms are classified as “complex” in each period if they at some point during the period have any convertible debt outstanding.

Exhibit 4
Cumulative Returns on Securities during Sample Period

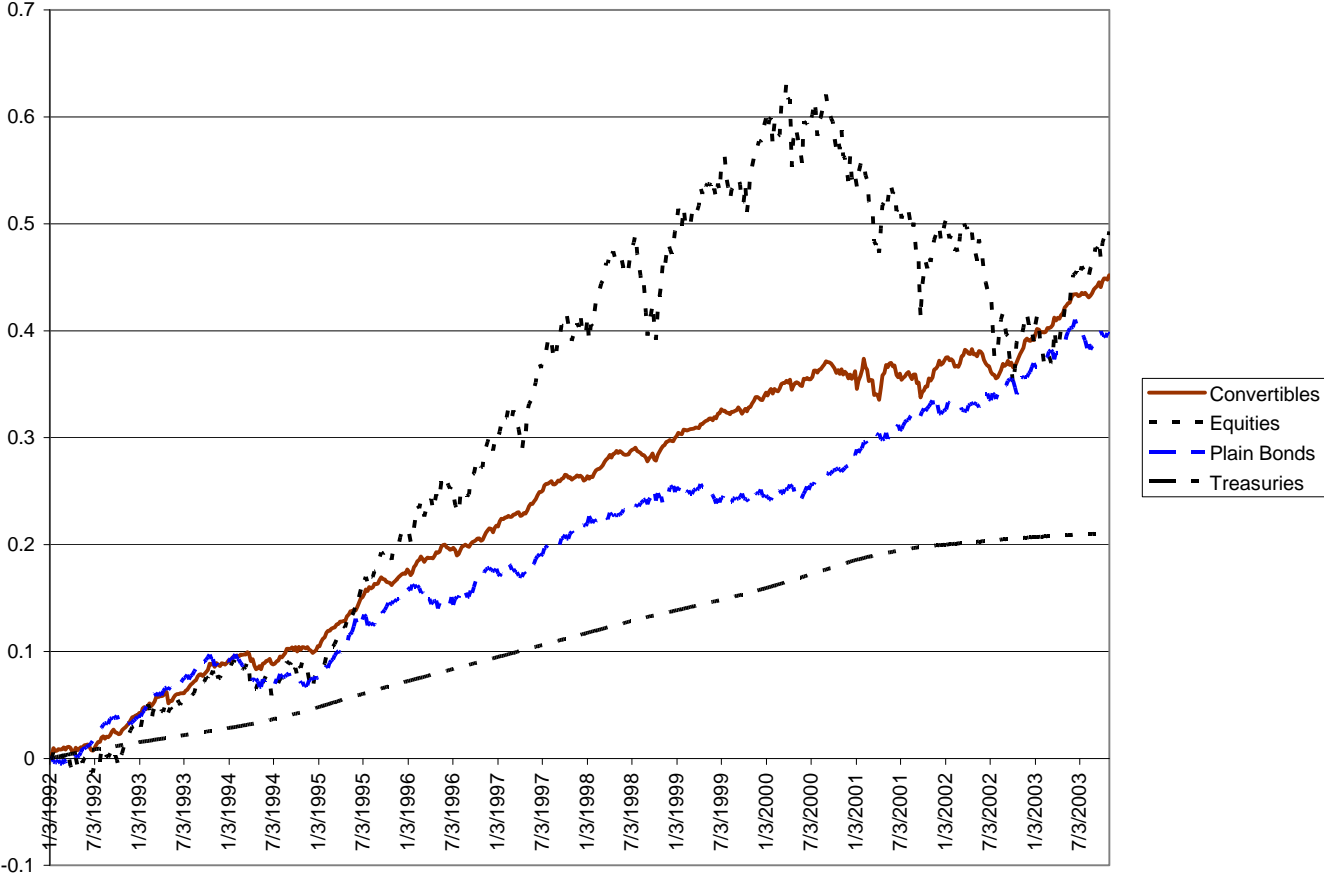


Exhibit 5
Complexity Metric Statistics

	Average	Median
Number of firms rated as non-zero on complexity metric per week	210	186
Total firms in sample per week	787	826
<i>Complexity Metric</i>		
Value of metric, total sample	0.037	0.000
Value of metric, firms with zero measures excluded	0.137	0.099
<i>Weighted Complexity Metric</i>		
Value of metric, total sample	0.057	0.000
Value of metric, firms with zero measures excluded	0.383	0.368

Note: This exhibit gives some summary statistics for the measure of capital structure complexity used in testing for all firms in the sample from January 1992- October 2003. The Complexity Metric is defined as the total market value of a firm's convertible bonds divided by the total market value of a firm's convertible bonds, plain vanilla bonds, and equity. Where bond market values are missing, we substitute the issue amount of each bond. The Weighted Complexity Metric is calculated in a similar fashion to the Complexity Metric, but with the value of firms' convertible bond (in both the numerator and denominator) multiplied by the number of years until each convertible bond's maturity.

Exhibit 6
Portfolio Returns for “Long Equity of Complex Firms/Short Equity of Simple Firms”

	Alpha	Rm-Rf	SMB	HML	UMD	Adj.R²
Complex	-3.61%	1.12	0.01	-0.06		0.9182
	<i>-2.65</i>	<i>50.19</i>	<i>0.35</i>	<i>-1.00</i>		
Simple	-2.68%	1.13	0.02	-0.06	-0.05	0.9164
	<i>-1.80</i>	<i>44.62</i>	<i>0.57</i>	<i>-1.18</i>	<i>-1.63</i>	
Hedge-All Convertibles	0.39%	0.96	-0.24	0.25		0.9499
	<i>0.54</i>	<i>58.98</i>	<i>-8.98</i>	<i>6.91</i>		
Upper quartile (UQ)	0.03%	0.96	-0.24	0.26	0.01	0.9487
	<i>0.04</i>	<i>52.04</i>	<i>-8.16</i>	<i>7.06</i>	<i>0.48</i>	
Lower quartile (LQ)	-3.99%	0.17	0.25	-0.30		0.4168
	<i>-2.20</i>	<i>4.73</i>	<i>4.74</i>	<i>-3.56</i>		
Hedge - UQ-LQ	-2.72%	0.16	0.26	-0.32	-0.07	0.4278
	<i>-1.29</i>	<i>4.00</i>	<i>4.24</i>	<i>-3.78</i>	<i>-1.18</i>	
Weighted upper quartile (WUQ)	-4.30%	1.18	0.13	0.01		0.9026
	<i>-2.61</i>	<i>40.61</i>	<i>2.66</i>	<i>0.13</i>		
Weighted lower quartile (WLQ)	-3.03%	1.17	0.12	-0.04	-0.12	0.9084
	<i>-1.95</i>	<i>35.96</i>	<i>2.34</i>	<i>-0.74</i>	<i>-3.71</i>	
WUQ-WLQ	1.14%	1.00	-0.25	0.25		0.9099
	<i>1.04</i>	<i>52.64</i>	<i>-7.85</i>	<i>5.51</i>		
Weighted upper quartile (WUQ)	0.79%	1.01	-0.24	0.27	0.02	0.9089
	<i>0.62</i>	<i>49.72</i>	<i>-7.04</i>	<i>6.08</i>	<i>0.69</i>	
Weighted lower quartile (WLQ)	-5.38%	0.18	0.39	-0.24		0.3768
	<i>-2.49</i>	<i>4.28</i>	<i>5.52</i>	<i>-2.41</i>		
WUQ-WLQ	-3.79%	0.15	0.36	-0.31	-0.14	0.4034
	<i>-1.63</i>	<i>3.20</i>	<i>4.73</i>	<i>-3.61</i>	<i>-2.42</i>	
WUQ-WLQ	-4.54%	1.15	-0.09	0.18		0.8336
	<i>-2.28</i>	<i>27.32</i>	<i>-1.92</i>	<i>2.91</i>		
WUQ-WLQ	-3.05%	1.15	-0.08	0.17	-0.08	0.8342
	<i>-1.54</i>	<i>27.63</i>	<i>-1.87</i>	<i>2.78</i>	<i>-2.98</i>	
WUQ-WLQ	1.77%	0.99	-0.26	0.24		0.897
	<i>1.33</i>	<i>41.15</i>	<i>-7.54</i>	<i>5.13</i>		
WUQ-WLQ	1.47%	1.00	-0.25	0.26	0.01	0.8957
	<i>0.99</i>	<i>38.06</i>	<i>-7.06</i>	<i>5.28</i>	<i>0.17</i>	
WUQ-WLQ	-6.20%	0.16	0.17	-0.06		0.1169
	<i>-2.48</i>	<i>2.80</i>	<i>2.78</i>	<i>-0.61</i>		
WUQ-WLQ	-4.46%	0.15	0.17	-0.09	-0.09	0.1286
	<i>-1.69</i>	<i>2.50</i>	<i>2.67</i>	<i>-0.99</i>	<i>-1.90</i>	

Note: This exhibit shows the results from multi-factor equity time-series regressions over the 1992- 2003 sample period. The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(DEF_t) + b_2(TERM_t) + e_t$, for $p =$ portfolio. It is then re-estimated with momentum factor (UMD). Hedge portfolios are long in the equity of complex (upper quartile) firms and short in the equity of simple (lower quartile) firms. Newey-adjusted t-statistics are in italics below each coefficient estimate.

Exhibit 7
Portfolio Returns for “Long Convertible Bonds”

	Alpha	DEF	TERM	Rm-Rf	SMB	HML	UMD	Adj.R²
All Convertibles	4.43%	0.28	0.16					0.0107
	<i>3.32</i>	<i>2.29</i>	<i>2.34</i>					
	3.19%	0.04	0.03	0.24	0.08	0.03	-0.04	0.5703
	<i>3.06</i>	<i>0.46</i>	<i>0.52</i>	<i>10.40</i>	<i>4.05</i>	<i>1.10</i>	<i>-1.69</i>	
	3.27%			0.24	0.08	0.03	-0.04	0.5713
	<i>2.97</i>			<i>11.10</i>	<i>4.10</i>	<i>1.24</i>	<i>-1.72</i>	
3.40%			0.23				0.5514	
<i>3.90</i>			<i>12.19</i>					
High Complexity	3.98%	0.34	0.20					0.0162
	<i>2.84</i>	<i>2.78</i>	<i>2.92</i>					
	2.58%	0.10	0.07	0.24	0.08	0.03	-0.05	0.5662
	<i>2.38</i>	<i>1.13</i>	<i>1.18</i>	<i>10.13</i>	<i>3.91</i>	<i>1.28</i>	<i>-1.86</i>	
	2.78%			0.24	0.08	0.04	-0.05	0.5606
	<i>2.41</i>			<i>10.94</i>	<i>3.97</i>	<i>1.50</i>	<i>-1.90</i>	
3.07%			0.23				0.5382	
<i>3.23</i>			<i>11.79</i>					
Weighted High Complexity	3.23%	0.19	0.14					0.0202
	<i>3.39</i>	<i>2.46</i>	<i>3.24</i>					
	2.11%	0.04	0.06	0.15	0.08	0.07	-0.01	0.4580
	<i>2.90</i>	<i>0.56</i>	<i>1.49</i>	<i>13.49</i>	<i>6.61</i>	<i>4.33</i>	<i>-1.88</i>	
	2.21%			0.16	0.08	0.07	-0.01	0.4447
	<i>2.95</i>			<i>13.82</i>	<i>6.75</i>	<i>4.81</i>	<i>-1.15</i>	
2.82%			0.13				0.4038	
<i>4.06</i>			<i>13.06</i>					

Note: This exhibit shows results from multifactor bond time-series regressions over the 1992-2003 sample period. The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(DEF_t) + b_2(TERM_t) + e_t$, for $p =$ portfolio. Regressions are then re-estimated using various combinations of the market ($Mkt-R_f$), size (SMB), book-to-market (HML), and momentum (UMD) factors. Newey-adjusted t-statistics are in italics below each coefficient estimate.

Exhibit 8
Portfolio Returns for “Long Convertible Bonds/Short Equity of Complex Firms”

	Alpha	DEF	TERM	Rm-Rf	SMB	HML	UMD	Adj.R ²
Hedge-All Convertibles	4.00%	0.09	0.06					0.0007
	<i>5.05</i>	<i>1.02</i>	<i>1.11</i>					
	3.76%	0.03	0.04	0.01	0.08	0.04	-0.04	0.0615
	<i>3.61</i>	<i>0.33</i>	<i>0.73</i>	<i>0.43</i>	<i>4.58</i>	<i>1.32</i>	<i>-1.33</i>	
	3.84%			0.01	0.08	0.04	-0.03	0.0584
	<i>3.41</i>			<i>0.57</i>	<i>4.34</i>	<i>1.54</i>	<i>-1.25</i>	
4.26%			0.00				-0.0013	
<i>4.92</i>			<i>-0.20</i>					
Hedge-High Complexity	3.56%	0.10	0.08					0.0052
	<i>4.62</i>	<i>1.30</i>	<i>1.57</i>					
	3.28%	0.06	0.07	0.01	0.06	0.04	-0.03	0.0446
	<i>3.26</i>	<i>0.72</i>	<i>1.23</i>	<i>0.28</i>	<i>4.28</i>	<i>1.43</i>	<i>-1.14</i>	
	3.41%			0.01	0.06	0.05	-0.02	0.0353
	<i>3.13</i>			<i>0.47</i>	<i>3.92</i>	<i>1.73</i>	<i>-1.01</i>	
3.92%			-0.01				-0.0006	
<i>4.54</i>			<i>-0.36</i>					
Hedge-Weighted High Complexity	2.87%	0.08	0.08					0.0181
	<i>3.84</i>	<i>1.04</i>	<i>1.71</i>					
	2.50%	0.05	0.07	0.00	0.09	0.04	0.00	0.1309
	<i>3.43</i>	<i>0.75</i>	<i>1.79</i>	<i>0.10</i>	<i>7.08</i>	<i>2.38</i>	<i>-0.42</i>	
	2.66%			0.00	0.08	0.04	0.00	0.1005
	<i>3.52</i>			<i>0.39</i>	<i>7.13</i>	<i>2.80</i>	<i>0.44</i>	
3.25%			-0.01				0.0033	
<i>4.24</i>			<i>-1.26</i>					

Note: This exhibit shows results from multifactor bond and equity time-series regressions over the 1992-2003 sample period for issue-weighted convertible bonds and value-weighted equity hedge portfolios, with an unequal hedge ratio. The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(DEF_t) + b_2(TERM_t) + e_{1,t}$, for p = portfolio, for the default (DEF) and term structure (TERM) factors. The regression is then estimated using various combinations of the market (Mkt- R_f), size (SMB), book-to-market (HML), and momentum (UMD) factors. Hedge portfolios are long in convertibles bonds firms and short in equities of firms with convertible bonds outstanding. The Hedge-All Convertibles and Hedge-High Complexity portfolios employ a five-to-one hedge ratio between the long and short portfolios; The Hedge-Weighted High Complexity portfolio employs a seven-and-three-quarters-to-one hedge ratio. Newey-adjusted t-statistics are in italics below each coefficient estimate.

Exhibit 9
Multifactor Asset Pricing Tests with Liquidity Risk Factor Proxy
Portfolio Returns for “Long Equity of Complex Firms/Short Equity of Simple Firms”

	Alpha	Rm-Rf	SMB	HML	UMD	Vol	Adj.R ²
Hedge – All Convertibles	4.35%	0.17	0.25	-0.30		0.00	0.4175
	<i>0.89</i>	<i>4.66</i>	<i>4.79</i>	<i>-3.63</i>		<i>-1.73</i>	
	5.31%	0.16	0.26	-0.33	-0.07	0.00	0.4282
	<i>0.97</i>	<i>3.89</i>	<i>4.26</i>	<i>-3.87</i>	<i>-1.18</i>	<i>-1.45</i>	
Hedge-High Complexity	-2.67%	0.18	0.39	-0.24		0.00	0.3759
	<i>-0.42</i>	<i>4.24</i>	<i>5.52</i>	<i>-2.42</i>		<i>-0.40</i>	
	2.85%	0.15	0.36	-0.31	-0.14	0.00	0.4031
	<i>0.42</i>	<i>3.12</i>	<i>4.75</i>	<i>-3.68</i>	<i>-2.42</i>	<i>-0.94</i>	
Hedge – Weighted High Complexity	-2.36%	0.16	0.17	-0.06		0.00	0.1158
	<i>-0.39</i>	<i>2.77</i>	<i>2.79</i>	<i>-0.62</i>		<i>-0.58</i>	
	-2.06%	0.15	0.17	-0.09	-0.09	0.00	0.1272
	<i>-0.31</i>	<i>2.47</i>	<i>2.67</i>	<i>-0.99</i>	<i>-1.90</i>	<i>-0.31</i>	

Note: This exhibit includes the results from multi-factor equity time-series regressions over the 1992- 2003 sample period, including the liquidity risk factor proxy, the log of the average daily NYSE trading volume over the relevant trading week (Vol). The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(Mkt_t - R_{f,t}) + b_2(HML_t) + b_3(SMB_t) + b_4(Vol_t) + e_t$, for $p =$ portfolio. It is then re-estimated with momentum factor (UMD). Hedge portfolios are long in the equity of complex (upper quartile) firms and short in the equity of simple (lower quartile) firms. Newey-adjusted t-statistics are in italics below each coefficient estimate.

Exhibit 10
Multifactor Asset Pricing Tests with Liquidity Risk Factor Proxy
Portfolio Returns for “Long Convertible Bonds”

	Alpha	DEF	TERM	Rm-Rf	SMB	HML	UMD	Vol.	Adj.R²
All Convertibles	5.97%	0.28	0.16					0.00	0.0093
	<i>1.45</i>	<i>2.29</i>	<i>2.34</i>					<i>-0.35</i>	
	3.64%	0.04	0.03	0.24	0.08	0.03	-0.04	0.00	0.5696
	<i>1.38</i>	<i>0.45</i>	<i>0.52</i>	<i>10.48</i>	<i>4.04</i>	<i>1.11</i>	<i>-1.69</i>	<i>-0.16</i>	
	3.73%			0.24	0.08	0.03	-0.04	0.00	0.5705
	<i>1.45</i>			<i>11.15</i>	<i>4.08</i>	<i>1.24</i>	<i>-1.71</i>	<i>-0.16</i>	
2.40%			0.23				0.00	0.5508	
<i>0.91</i>			<i>12.18</i>				<i>0.36</i>		
High Complexity	4.31%	0.34	0.20					0.00	0.0146
	<i>1.00</i>	<i>2.78</i>	<i>2.92</i>					<i>-0.07</i>	
	2.31%	0.11	0.07	0.24	0.08	0.03	-0.05	0.00	0.5609
	<i>0.82</i>	<i>1.11</i>	<i>1.17</i>	<i>10.23</i>	<i>3.90</i>	<i>1.29</i>	<i>-1.86</i>	<i>0.09</i>	
	2.57%			0.24	0.08	0.04	-0.05	0.00	0.5599
	<i>0.92</i>			<i>11.01</i>	<i>3.95</i>	<i>1.51</i>	<i>-1.90</i>	<i>0.07</i>	
0.86%			0.23				0.00	0.5379	
<i>0.29</i>			<i>11.79</i>				<i>0.71</i>		
Weighted High Complexity	6.46%	0.19	0.14					0.00	0.0207
	<i>2.17</i>	<i>2.45</i>	<i>3.23</i>					<i>-1.15</i>	
	3.86%	0.04	0.06	0.15	0.08	0.06	-0.01	0.00	0.4577
	<i>1.78</i>	<i>0.54</i>	<i>1.47</i>	<i>13.46</i>	<i>6.64</i>	<i>4.29</i>	<i>-1.88</i>	<i>-0.87</i>	
	3.82%			0.16	0.08	0.07	-0.01	0.00	0.4442
	<i>1.66</i>			<i>13.75</i>	<i>6.77</i>	<i>4.76</i>	<i>-1.14</i>	<i>-0.75</i>	
4.54%			0.13				0.00	0.4034	
<i>1.95</i>			<i>12.97</i>				<i>-0.81</i>		

This exhibit gives the results from multifactor bond time-series regressions over the 1992-2003 sample period, including the liquidity risk factor proxy, the log of the average daily NYSE trading volume over the relevant trading week (Vol). The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(DEF_t) + b_2(TERM_t) + b_3(Vol_t) + e_t$, for p=portfolio. Regressions are then re-estimated using various combinations of the market (Mkt - R_f), size (SMB), book-to-market (HML), and momentum (UMD) factors. Newey-adjusted t-statistics are in italics below each coefficient estimate.

Exhibit 11
Multifactor Asset Pricing Tests with Liquidity Risk Factor Proxy
Portfolio Returns for “Long Convertible Bonds/Short Equity of Complex Firms”

	Alpha	DEF	TERM	Rm-Rf	SMB	HML	UMD	Vol.	Adj.R ²
Hedge-All Convertibles	2.17%	0.09	0.06					0.00	-0.0003
	<i>0.80</i>	<i>1.02</i>	<i>1.11</i>					<i>0.67</i>	
	3.44%	0.03	0.04	0.01	0.08	0.04	-0.04	0.00	0.0599
	<i>1.26</i>	<i>0.33</i>	<i>0.72</i>	<i>0.43</i>	<i>4.56</i>	<i>1.33</i>	<i>-1.33</i>	<i>0.11</i>	
	3.44%			0.01	0.08	0.04	-0.03	0.00	0.0568
	<i>1.25</i>			<i>0.58</i>	<i>4.32</i>	<i>1.55</i>	<i>-1.25</i>	<i>0.14</i>	
2.45%				0.00			0.00	-0.0023	
	<i>0.90</i>			<i>-0.19</i>			<i>0.64</i>		
Hedge-High Complexity	1.44%	0.10	0.08					0.00	0.0045
	<i>0.56</i>	<i>1.30</i>	<i>1.57</i>					<i>0.81</i>	
	2.47%	0.06	0.07	0.01	0.06	0.04	-0.03	0.00	0.043
	<i>0.93</i>	<i>0.72</i>	<i>1.22</i>	<i>0.29</i>	<i>4.27</i>	<i>1.45</i>	<i>-1.14</i>	<i>0.29</i>	
	2.53%			0.01	0.06	0.05	-0.02	0.00	0.0338
	<i>0.93</i>			<i>0.49</i>	<i>3.91</i>	<i>1.75</i>	<i>-1.01</i>	<i>0.31</i>	
1.83%				-0.01			0.00	-0.0013	
	<i>0.69</i>			<i>-0.35</i>			<i>0.76</i>		
Hedge-Weighted High Complexity	4.28%	0.08	0.08					0.00	0.02
	<i>1.84</i>	<i>1.04</i>	<i>1.70</i>					<i>-0.64</i>	
	4.45%	0.05	0.07	0.00	0.04	0.09	0.00	0.00	0.13
	<i>2.09</i>	<i>0.75</i>	<i>1.79</i>	<i>0.07</i>	<i>2.34</i>	<i>7.13</i>	<i>-0.44</i>	<i>-1.01</i>	
	4.42%			0.00	0.04	0.09	0.00	0.00	0.10
	<i>1.93</i>			<i>0.37</i>	<i>2.77</i>	<i>7.19</i>	<i>0.42</i>	<i>-0.84</i>	
4.75%				-0.01			0.00	0.00	
	<i>1.91</i>			<i>-1.27</i>			<i>-0.64</i>		

This exhibit gives the results from multifactor bond and equity time-series regressions over the 1992-2003 sample period for issue-weighted convertible bonds and value-weighted equity hedge portfolios, with an unequal hedge ratio. All regressions include the liquidity risk factor proxy, the log of the average daily NYSE trading volume over the relevant trading week (Vol). The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(DEF_t) + b_2(TERM_t) + b_3(Vol_t) + e_t$, for p=portfolio, for the default (DEF) and term structure (TERM) factors. The regression is then estimated using various combinations of the market (Mkt - R_f), size (SMB), book-to-market (HML), and momentum (UMD) factors. Hedge portfolios are long in convertibles bonds firms and short in equities of firms with convertible bonds outstanding. The Hedge-All Convertibles and Hedge-High Complexity portfolios employ a five-to-one hedge ratio between the long and short portfolios; The Hedge-Weighted High Complexity portfolio employs a seven-and-three-quarters-to-one hedge ratio. Newey-adjusted t-statistics are in italics below each coefficient estimate.