A Liquidity-Based Explanation of Convertible Arbitrage Alphas

George Batta[1]
Assistant Professor of Economics, Claremont McKenna College

George Chacko
Managing Partner, 6S Capital GmbH
Associate Professor of Finance, Santa Clara University
Managing Director, Trinsum Group

Bala G. Dharan
Vice President, CRA International, Inc.
Visiting Professor of Accounting, Harvard Law School
J. Howard Creeekmore Professor of Accounting, Rice University

June 2008

We would like to thank seminar participants at Harvard Business School's Work-In-Progress seminar, Boston College, Santa Clara University, the CFA Institute, and the State Street Research Retreat, the Board of Governors, and numerous financial institutions where parts of this paper have been presented. We are especially indebted to Robert Merton and Erik Stafford for thought-provoking discussions.

[1] Corresponding author. Address: 500 E. 9th St., Claremont, CA 91711. Ph: (909)607-7260. Fax: (909)621-8249. email: gbatta@cmc.edu.

A Liquidity-Based Explanation of Convertible Arbitrage Alphas

I. INTRODUCTION

The hedge fund industry has grown from less than $100 billion in assets under management in 1994 to over $1.9 trillion today.[2] One of the oldest investment strategies employed by the hedge fund industry is convertible arbitrage, with over $42 billion in investments.[3] Hedge fund managers employing this strategy 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. Hedge funds employing convertible arbitrage have reportedly earned significant and persistent excess returns over the last decade, with some studies reporting annual excess returns for the strategy in the range of 10% to 18%.[4]

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 outperformance over the years presents a puzzle in finance. If transaction costs are low, and assuming relative abundance of human and financial capital to be devoted to the strategy, the abnormal returns earned by convertible arbitrage funds

---

[2] 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).

[3] Based on industry data reported by Barclay Trading Group Ltd. (See footnote 1.) Excludes investments in Fund of Funds and Multi-Strategy Funds categories. The total value of US convertible bonds outstanding as of May 2005 was $255 billion (Merrill Lynch, 2005).

[4] 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.

in their early history should have quickly disappeared over time. Hence the strategy's continued and large-scale use by hedge fund managers calls for exploring alternative risk-based or pricing-based explanations for the observed abnormal returns. Our main objective in this paper is to examine the extent to which the excess returns from convertible arbitrage represent compensation for managers' exploitation of pricing inefficiencies in the market or merely compensation for bearing some form of systematic risk.

Only recently have hedge fund returns databases not plagued by survivorship bias become available. Consequently, the finance literature has only recently started to address the question of the sources of positive returns to hedge fund strategies, and more specifically convertible arbitrage.[5] Brooks and Kat (2002) document that hedge fund indices exhibit highly unusual skewness, kurtosis, and first-order serial correlations relative to popular stock and bond indices, which suggests that reliance on a mean-variance framework for investment evaluation will understate the risks attendant upon hedge fund investments. Consistent with this explanation, Fung and Hsieh (2001) find that hedge funds exhibit option-like payoff structures, with state-dependent betas that are positive in up markets and negative in down markets. Given these and other nonlinear return features of hedge fund indices, traditional linear factor models of investment styles using standard asset benchmarks will tend to understate the systematic risk of hedge funds. Similarly, Mitchell and Pulvino (2001) find that returns to M&A risk arbitrage, in which fund managers attempt to profit from the difference between a merger target's offer price and stock price, resemble those obtained by selling uncovered put options. As a result, investment evaluation of this strategy must control for its nonlinear relationship with market

[5] Examples include AltVest, Hedge Fund Research, Managed Account Reports, and TASS. Ackerman, McEnally, and Ravenscraft (1999), Brown, Goetzmann, and Ibbotson (1999), Liang (1999), Fung and Hsieh (2000), and Edwards and Caglayan (2001) all present detailed empirical analyses of hedge fund returns using these databases.

returns. Agarwal and Naik (2004) employ a similar reasoning and find that modeling hedge fund returns as a nonlinear function of risk factors allows for proper pricing of negative tail risk that appears to be endemic to hedge fund strategies.

Agarwal and Naik (2000), Brown and Goetzmann (2003), and Asness, Krail, and Liew (2001) all document the presence of serial correlation in hedge fund returns. Getmansky, Lo, and Makarov (2004) also find serial correlation in hedge fund returns and hypothesize that these may be due to illiquidity in hedge fund holdings, but do no formal testing of this hypothesis and have no explanation for the excess returns of convertible arbitrage.[6] Examining convertible arbitrage specifically, Agarwal et al. (2007) find an explanation for the strategy's excess returns ("alphas") in the original issue discount for the convertible bonds in the primary market. Their study, however, does not seek to distinguish between market inefficiency and liquidity risk explanations for the alphas.

Our empirical tests confirm that any seeming abnormal returns to convertible arbitrage represent compensation for greater exposure to liquidity risk, which we argue arises not only from arbitrageurs' holding a long position in illiquid convertible debt securities and a short position in liquid equity securities but also from diminished liquidity in the *equity* markets of convertible debt issuers. 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.

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

[6] It is important to note that the presence of serial correlation is not necessarily a violation of the Efficient Markets Hypothesis. LeRoy (1973), Rubinstein (1976), and Lucas (1978) all have shown that serial correlation in asset returns need not be the result of market inefficiencies but instead can arise from time-varying expected returns.

risk in the portfolio and magnifies (with leverage) the quantity of liquidity risk.[7] The liquidity risk in the strategy comes about from the fact that corporate bonds are typically several orders of magnitude more illiquid than equities.[8] 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.

Liquidity risk has received considerable attention in both the academic literature and, more recently, in the business press, owing to financial market disruptions in late Summer 2007 caused by liquidity problems in the subprime mortgage securitization market. Many recent papers have investigated the importance of liquidity for explaining returns, using data from the equity markets. Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), Brennan, Chordia and Subrahmanyam (1998), Datar, Naik and Radcliffe (1998), Chordia, Roll and Subrahmanyam (2002) have all found positive relationships between stock returns and overall

[7] 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.

[8] See, for example, Edwards, Harris, and Piwowar (2007).

liquidity as measured by spreads, depth, and volume. However, Chordia, Subrahmanyam and Anshuman (2001) find a negative relationship between liquidity and expected returns, while Hasbrouck and Seppi (2001) find no relationship. Finally, Huberman and Halka (2001) and Pastor and Stambaugh (2003) examined the question of whether liquidity risk is systematic. Both papers find substantial systematic components in liquidity risk.

The mixed results on liquidity pricing in the equity markets is likely the result of performing liquidity tests in a market where liquidity is pervasive and therefore, an unimportant characteristic – in fact, next to the Treasury market, the US equity market is the most liquid in the world. Work done in more illiquid markets, where the effects of illiquidity are pronounced, seem to indicate that liquidity risk is in fact priced. For example, Chacko (2006) analyzes the question of whether liquidity risk is priced in the US corporate bond market – a market where little trading occurs[9]– by utilizing holdings data instead of trading data.[10] Using data for the corporate bond market (excluding convertible corporate bonds), he found strong evidence for a systematic liquidity risk factor. Similar results are obtained in Chacko, et. al. (2008). Given this consistent set of results for corporate bonds, one should expect that liquidity risk should be an important factor in the markets for convertible bonds also, since these instruments are typically even less liquid than plain corporate bonds. As a result, in portfolios going long convertible debt and short other securities in a firm's capital structure, especially equity, fund managers are bearing significant liquidity risk, and therefore at least part of the seemingly abnormal returns they generate is fair compensation for bearing this liquidity risk – the question is how much.

Consistent with prior literature, we also assess whether primary market participants earn returns in excess of compensation for bearing liquidity risk on these securities closer to their

[9] Edwards, Harris, and Piwowar (2007) using TRACE data show that the median corporate bond issue experiences a trading frequency of less than once per year.
[10] See also Chacko et al. (2007).

issuance date. To induce primary market participants to supply ready capital to firms issuing convertible debt, issuers typically offer a discount on these securities. Chacko, et al. (2007) posit that this discount represents the price of "immediacy" for supplying capital and liquidity to the seller of a security. Whether this original issue discount represents fair or excess compensation for bearing liquidity risk has not been explored in prior literature, and we address this gap in subsequent empirical tests.

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 security like convertible debt, as trading may be deterred from trading in their now more difficult-to-value securities affected by the debt's conversion option. 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. 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.

Huang and Wang (2000), building on Allen and Gale (1984) and Grossman and Miller (1988), 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. Drawing on Huang and Wang's model, we hypothesize then that participants in the equity markets of firms with convertible debt will suffer from heightened liquidity risk as a result of greater participation costs, and thus equity returns for these firms will be more highly correlated with systematic liquidity risk factor proxies.[11]

We also hypothesize that exposure to liquidity risk, brought on by capital structure complexity, will be increasing in the portion of firms' capital structure composed of convertible debt: Consequences of valuation errors from misestimating the likelihood of exercise will be more severe in this case, which will effectively serve to increase participation costs. For example, take a firm with assets having an equal probability of being worth $100 or $50 in one year's time, so enterprise value at time zero is $75 (assume a zero discount rate). If the firm's capital structure is composed of 75% equity and 25% convertible debt (with a corresponding conversion ratio) at time zero, then mistakenly assuming debtholders will exercise the conversion option in the bad state of the world will result in a pricing error of less than six percent. If the firm's capital structure is composed of 50% convertible debt, then mistakenly assuming debtholders will exercise the conversion option in the bad state will result in a pricing error of twenty percent. If the firm's capital structure is composed of 90% convertible debt, the pricing error will be as large as fifty percent.

[11] We detail the nuances of convertible bond accounting according to U.S. Generally Accepted Accounting Principles in the paper's **Appendix**. The increased number and complexity of accounting standards governing this type of security attest to the difficulties inherent in estimating its value.

Avoiding large pricing errors like this will demand more effort and training from potential investors and thus further raise the costs of participation, with attendant effects on the liquidity of market for the firm's equity. As such, when convertible debt composes an even larger portion of firm's capital structure, we expect the equity markets of firms with convertible debt to be even more exposed to liquidity risk, and return patterns will be more highly correlated with systematic liquidity risk factor proxies.

Consistent with these explanations, the empirical tests we conduct below show that almost all abnormal returns are produced from greater exposure to liquidity risk. For all of the convertible arbitrage strategies we examine, the 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 in, although there do appear to be some abnormal returns generated closer to convertible bonds' issuance dates.

The results have implications for pension fund and other institutional investors assessing the risk and return characteristics of this type of investment for inclusion in their portfolios, for investors in the equity and plain debt of firms issuing convertible debt, and for regulators assessing impact of hybrid securities on investor perceptions of firm risk and value. The results of this paper may appear at odds with the relatively high 2/20 fees charged by convertible arbitrage funds – after all, are 2/20 fees really appropriate for simply producing returns primarily attributable to a systematic risk factor? In the case of liquidity risk, we argue that it may very well be reasonable. The most obvious investors for bearing liquidity risk are long-horizon investors, for whom the need for liquidity is minimal – examples include pension funds, endowments, insurance companies, foundations, etc., all of whom have long-dated liabilities. However for these investors, finding a fund whose primary systematic risk exposure is liquidity risk rather than market risk is not trivial – one cannot simply go out and buy a “liquidity risk index fund” as is possible for many other systematic risk exposures. Isolating liquidity risk in a fund is a complex task of financial engineering, requiring the careful measurement and hedging of various market risk exposures, and probably deserving of higher fees than putting together a typical index fund. The convertible arbitrage industry performs exactly this financial engineering task, and therefore, their relatively high fees may very well be justified.

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.

II. METHODOLOGY

a. Data Description

Weekly data on bond prices, market values, issue amounts, and issue dates for 1992 to October 2003 were obtained from Datastream. Our sample period precedes the issuance of EITF 04-08 which made significant changes to the calculation of EPS dilution effects of certain types of convertible bonds. 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 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 Table 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 Table 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 Table 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. Chart 1 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.

b. 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 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.[12]

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

Table 4 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 (median) of 13.7% (9.9%) of firms' capital structure is composed of convertible debt, while the weighted capital structure metric registers an average (median) level of 38.3% (36.8%).

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.

c. 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, 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 absent convertible debt. The number of firms absent 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. 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.[13]

---

[13] Consistent with this, later regression results suggest that a five-to-one convertible bond-to-equity hedge ratio largely eliminates exposure to the market factor.

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 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-Equityof 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[14]: (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

[14] Fama and French (1992).

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 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 an initial 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.

III. EMPIRICAL RESULTS

a. Basic tests

Table 5 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 is 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 (UWQ), abnormal returns fall to -4.54%.[15]

Interestingly, in light of summary statistics in Table 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 UWQ 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 absent 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 absent 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

[15] 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).

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 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.[16] 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 Table 6 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

[16] 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 UWQ portfolios. Constant estimates in all of these regressions are statistically insignificant at conventional levels.

decrease in abnormal returns: Averaging abnormal returns across all risk models, we 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 Table 7 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 2.9%. Return patterns among the three sets of equity portfolios listed in Table 5 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 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 portfoios.[17]

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.

These results, absent any adjustment for liquidity risk, initially suggest some degree of mispricing in convertible bonds, and even the equity of issuing firms. Perhaps the complexities associated with pricing hybrid securities, and estimating their effects on the value of the simpler parts a firm's capital structure, cause large numbers of investors to make systematic pricing errors, which are not speedily enough corrected at the weekly return horizon level we employ in our tests. However, empirical results reported in the next section, not to mention convertible arbitrage's standing as one of the oldest and best-known arbitrage strategies, cast doubt on this interpretation.

---

[17] As shown on Table 6, convertible bonds in the Weighted High Complexity portfolio have greater exposure to the market factor (Mkt_t-$R_{f,t}$) than bonds in the All Convertibles and High Complexity portfolios: The regression coefficient on the market factor ranges from 0.13 to 0.15 for the Weighted High Complexity bonds, relative to 0.23 to 0.24 for the All Convertibles and High Complexity Portfolios. This implies a somewhat higher hedge ratio for firms nearer to their issuance date. In untabulated tests, we adopt a seven-to-one hedge ratio; abnormal return magnitudes (for these as well as subsequent tests) are only around ten basis points lower, and all results remain statistically significant. As expected, the adjusted-R^2 for regressions using this more accurate hedge ratio, which better hedges out the impact of market fluctuations, is essentially halved, from 0.3151 to 0.1486 for the regression specification that uses the full suite of bond and equity risk factors.

b. Tests including liquidity factor

Results in Table 8, where tests on equity portfolio returns now include a liquidity risk factor proxy, tell quite different story from the initial results presented in Table 5. 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. All previously identified negative abnormal returns turn statistically insignificant when the log of NYSE volume is included in regressions. As we propose in Section I. 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 Table 6, Table 9 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 returns 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 the previously-documented (see Agarwal, et al (2007)) original issue discount corporate borrowers offer on these securities.

Table 10 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 (in almost all risk models) for firms in the time-to-maturity Weighted High Complexity portfolio, with annualized abnormal returns ranging from 3.1% to 5.0%. This reinforces the notion that any abnormal profits from convertible arbitrage are concentrated in convertible bonds closer to their issuance date. Importantly, 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 the Hedge-All Convertibles and 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 nearly all risk factor configurations.[18]

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

[18] The only exception is in regressions of Weighted High Complexity on All Convertibles portfolio returns where only the bond market (DEF and TERM) and liquidity risk factors are included. In these regressions, the constant (and thus abnormal return) estimates are statistically insignificant.

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.

VI. CONCLUSION

The results of our study indicate that—except for near-to-issuance-date convertible bonds—arbitrageurs are not capitalizing on pricing inefficiencies in the convertible debt of issuers, but are being compensated for exposure to liquidity risk, through strategies that do involve the purchase of convertible debt. More strikingly, we find that the equity market participants of firms with convertible debt suffer from heightened exposure to liquidity risk, relative to firms absent complex capital structure. The latter result is striking, and to our knowledge not documented elsewhere in the literature.

Most convertible arbitrage funds hedge out risk factors such as interest rate risk and default risk from their portfolios, but 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 simply a 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 risk[19]are reasonable. These hedge funds typically charge fees in the range of 2% of assets under management (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 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 taken liquidity risk, even after accounting for hedge fund fees, can be substantial.

[19] 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.

Appendix

Present US accounting standards for the classification and reporting of convertible debt date back to an era when option pricing models were unknown. Accounting Principles Board Opinion No. 14, "Accounting for Convertible Debt and Debt Issued with Stock Purchase Warrants,"issued in 1969, called for the classification of the proceeds of convertible debt upon issuance solely and fully as a liability item with no bifurcation of value to recognize the potential initial value of the equity component of the hybrid security. According to APB 14, the above non-bifurcation reporting requirement was motivated by the "the inseparability of the debt and the conversion option" and not on the "practical difficulties" of valuation of the conversion option.[20] This basic standard, which is still effective in the US today, also calls for the issuing company to maintain this unified classification throughout the life of the convertible debt even as the value of the option to convert changes subsequent to issuance.

Since the issuance of APB 14, the variety and complexity of convertible debt issued in the US have increased even further, making the accounting for these instruments even more poorly reflect a company's underlying financial economics and further clouding investors' valuation task. For example, traditional "plain-vanilla" convertible debt usually provided for "share settlement" (paid in shares) for the conversion value (conversion shares multiplied by the stock priced on the date of conversion) in whole upon exercise. In common variations of the conversion mechanism, the conversion value may be sometimes "cash settled," i.e., fully paid in cash rather than shares, or settled partially in cash and partially with shares at the issuer's option. In more recent variations, the issuer agrees to settle in cash for the stated principal amount of the debt and has the option to settle in shares or cash for the difference between the conversion value

[20] APB Opinion 14, para. 12 (Accounting Principles Board, 1969).

and the principal. These are sometimes referred to as treasury stock bonds, Instrument C convertibles (see below) or "net share-settled" convertibles.

The convertible notes issued by Omnicom Group provide an illustration of the complexity of the convertible securities and the difficulty investors might face in valuing their debt and equity components. The long-term debt of Omnicom primarily consists of four series of convertible notes, of a type known as contingently-convertible or "co-co" bonds. These are convertible only upon the occurrence of certain trigger events, including a stock price trigger. The notes of Omnicom also include a put option that could be exercised annually, as described below in the company's 2006 annual report:

> The holders of our 2031 Notes have the right to cause us to repurchase up to the entire aggregate principal amount of the notes then outstanding for par value in February of each year. The holders of our 2032 Notes have the right to cause us to repurchase up to the entire aggregate principal amount of the notes then outstanding for par value in August of each year. The holders of our 2033 Notes have the right to cause us to repurchase up to the entire aggregate principal amount of the notes then outstanding for par value on June 15, 2008, 2010, 2013, 2018, 2023 and on each June 15 annually thereafter through June 15, 2032. The holders of our 2038 Notes have the right to cause us to repurchase up to the entire aggregate principal amount of the notes then outstanding for par value on June 15, 2008, 2010, 2013, 2018, 2023 and on each June 15 annually thereafter through June 15, 2037. The 2031, 2032, 2033 and 2038 Notes are convertible, at specified ratios, only upon the occurrence of certain events, including: if our common shares trade above certain levels, if we effect extraordinary transactions or, in the case of the 2031 Notes and the 2032 Notes, if our long-term debt credit ratings are downgraded to BBB or lower by Standard & Poor's Ratings Service, or Baa3 or lower by Moody's Investors Service or in the case of the 2033 Notes and the 2038 Notes to BBB- or lower by S&P, and Ba1 or lower by Moody's. These events would not, however, result in an adjustment of the number of shares issuable upon conversion and would not accelerate the holder's right to cause us to repurchase the notes.[21]

Co-co bonds are generally issued at very low stated coupon rates relative to other convertible bonds (and plain bonds), indicating a relatively high equity component in these bonds. For these securities (and a related category of no-coupon no-discount convertible bonds known as "no-no" bonds) bifurcation of the equity component for accounting purposes would result in reporting the debt at an original issue discount, which would lead to higher interest expense (due to the amortizing of the discount) and a lower numerator value for earnings per

[21] Omnicom Group 2006 Annual Report, Page 26.

share (EPS), apart from other dilution effects on the denominator of EPS. Research suggests that firms issuing these types of complex convertible debt containing high levels of equity component might be especially subject to pricing errors by investors. Urcan and Kieschnick (2006), for example, find that firms issuing convertible debt with larger equity component generally show poor long run operating performance and manage their earnings more aggressively prior to issuance.

The Financial Accounting Standards Board (FASB) has responded to the increasing complexity and variety of convertible debt by issuing – through its Emerging Issues Task Force (EITF) – various clarifications and guides to implementing APB 14.[22] One of these, EITF 90-19[23], classifies convertible debt settled in cash only as Instrument A, convertible debt settled in shares or cash at the issuer's option as Instrument B, and convertible debt that pays cash up to the principal and cash or shares for the reminder as Instrument C. All three types should be accounted for as convertible debt as per APB 14, with no provision for the valuation of the conversion feature. However, for diluted earnings per share calculations, Instrument C was excluded from the use of the so-called if-converted method to determine the dilution effect. In EITF 07-2[24], the FASB is considering whether to require bifurcation for Instrument C-type and other similar types of convertible debt. According to the list of affected accounting standards given in EITF 07-2, the past pronouncements of the FASB related to convertible debt include FASB Statements 84, 150, and 155 , EITF Issues 96-19, 98-5, 00-19, 00-27, 03-7, 04-8, 05-1,

[22] Reflecting the delayed response nature of FASB rules, an analyst note commenting on a recent FASB proposal on convertible bond accounting was titled "Convertible Bonds II: FASB Plays Catch-Up with Market Innovations" (Bear Stearns, 2004).

[23] Financial Accounting Standards Board (1992).

[24] Financial Accounting Standards Board (2007).

05-2, 06-6, and 06-7, and EITF Topic D-72.[25] The number and complexity of these disclosure rules illustrate the difficulty faced by investors in pricing convertible debt and in inferring the future cash flow effects (from conversion) as well as diluted earnings per share effects.

[25] Among these rules, EITF 04-8 perhaps received the greatest attention from investors and analysts since it imposed significant modifications to the calculation of diluted earnings per share by issuers of contingently convertible debt. According to the data in Merrill Lynch (2005), the contingently convertible debt market in the US shrank by over $40 billion after the issuance of EITF 04-8, suggesting that these securities owed their popularity in part to their favorable earnings per share calculation effects that were subsequently eliminated by EITF 04-8. Consistent with this inference, Marquardt and Wiedman (2005) find that a firm's propensity to issue this type of bond was significantly associated with both the diluted EPS reduction that would occur if the bond was traditionally structured and with the firm's use of EPS-based compensation.

References

Accounting Principles Board (1969): Opinion No. 14, “Accounting for Convertible Debt and Debt Issued with Stock Purchase Warrants,” New York, AICPA.

Ackerman, C., R. McEnally, and D. Ravenscraft (1999): “The Performance of Hedge Funds: Risk, Return, and Incentives,” *Journal of Finance*, v54, 833-874.

Agarwal, V., W. Fung, Y. Loon, and N. Naik (2007): “Liquidity Provision in the Convertible Bond Market: Analysis of Convertible Arbitrage Hedge Funds,” Working Paper.

Agarwal, V. and N. Naik (2000): “Multi-period Performance Persistence Analysis of Hedge Funds Source,” *Journal of Financial and Quantitative Analysis*, v35, 327-342.

Agarwal, V., and N. Naik (2004): “Risks and Portfolio Decisions Involving Hedge Funds,” *The Review of Financial Studies*, v17, 63-98.

Amihud, Y. and H. Mendelson (1986): "Asset Pricing and the Bid-Ask Spread", *Journal of Financial Economics*, v17, 223-249.

Asness, C., R. Krail, and J. Liew (2001): “Do Hedge Funds Hedge?” *Journal of Portfolio Management*, v28, 6-19.

Bear Stearns (2004): “Bonds II: FASB Plays Catch-Up with Market Innovations.” April.

Brennan, M. and A. Subrahmanyam (1996): "Market Microstructure and Asset Pricing: On the Compensation for Illiquidity in Stock Returns", *Journal of Financial Economics*, v41, 441-464.

Brennan, M., T. Chordia, and A. Subrahmanyam (1998): "Alternative Factor Specifications, Security Characteristics and the Cross-Section of Expected Stock Returns", *Journal of Financial Economics*, v49, 345-373.

Brown, S. and W. Goetzmann (2003): “Hedge Funds with Style,” *Journal of Portfolio Management*,v29, 101-112.

Brown, S., W. Goetzmann, and R. Ibbotson (1999): “Offshore Hedge Funds: Survival and Performance 1989-1995,” *Journal of Business*, v72, 91-118.

Brooks, C., and H. M. Kat (2002): “The Statistical Properties of Hedge Fund Index Returns and their Implications for Investors,” *Journal of Alternative Investments*, v5, 26–44.

Chacko, G. (2006): “Liquidity Risk in the Corporate Bond Markets”, Working Paper.

Chacko, G., J. Jurek, E. Stafford (2008): “The Price of Immediacy”, v63, *Journal of Finance*.

Chacko, G., S. Mahanti, G. Mallik, A. Nashiket, and M. Subrahmanyam (2007): "The Determinants of Liquidity in the Corporate Bond Markets: An Application of Latent Liquidity," forthcoming in *Journal of Financial Economics*.

Chordia, T., R. Roll, and A. Subrahmanyam (2002): "Commonality in Liquidity," *Journal of Financial Economics*, v56, 3-28.

Chordia, T., A. Subrahmanyam, V. Anshuman (2001): "Trading Activity and Expected Stock Returns", *Journal of Financial Economics*, v59, 3-32.

Collin-Dufresne, P., R. Goldstein, and J. S. Martin (2001):"The Determinantsof Credit Spread Changes,"*Journal of Finance*,v56, 2177-2207.

Datar, V., N. Naik, R. Radcliffe (1998): "Liquidity and Stock Returns: An Alternative Test", *Journal of Financial Markets*, v1, 203-219.

Edwards, F. and M. Caglayan (2001): "Hedge Fund and Commodity Fund Investments in Bull and Bear Markets," *Journal of Portfolio Management*, v27, 97-108.

Edwards, A., L. Harris, and M. Piwowar (2007): "Corporate Bond Market Transparency and Transaction Costs," *Journal of Finance*, v62, 1421-1451.

Fama, E. and K. French (1992): "The Cross-Section of Expected Stock Returns," *Journal of Finance*, v47, 427-465.

Fama, E., and K. French (1993): "Common Risk Factors in the Returns of Bonds and Stocks," *Journal of Finance*, v33, 3-56.

Financial Accounting Standards Board (1992): "Convertible Bonds with Issuer Option to Settle for Cash upon Conversion," Emerging Issues Task Force Issue 90-19. Norwalk, CT: FASB.

Financial Accounting Standards Board (2007): "Accounting for Convertible Debt Instruments that Require or Permit Partial Cash Settlement upon Conversion," Emerging Issues Task Force Issue 07-2. Norwalk, CT: FASB.

Fung, W. and D. A. Hsieh (2000): "Performance Characteristics of Hedge Funds and Commodity Funds: Natural vs. Spurious Biases," *Journal of Financial and Quantitative Analysis*, v35, 291-307.

Fung, W. and D.A. Hsieh (2001): "The Risk in Hedge Fund Strategies: Theory and Evidencefrom Trend Followers," *Review of Financial Studies*, v14(2), 313-341.

Getmansky, M., A. Lo, and I. Makarov (2004): “An Econometric Model of Serial Correlation and Illiquidity in Hedge Fund Returns,” *Journal of Financial Economics*, v74(3), 529-610.

Hasbrouck, J. and D. Seppi (2001): "Common Factors in Prices, Order Flows, and Liquidity", *Journal of Financial Economics*, v59, 383-411.

Huberman, G. and D. Halka (2001): "Systematic Liquidity", *Journal of Financial Research*, v24, 161-178.

Jegadeesh, N., and S. Titman (1993): “Returns to Buying Winners and Selling Lowers: Implications for Stock Market Efficiency,” *Journal of Finance*, v48, 65-91.

LeRoy, S. (1973): “Risk Aversion and the Martingale Property of Stock Returns,” *International Economic Review*, v14, 436-446.

Liang, B. (1999): “On the Performance of Hedge Funds,” *Financial Analysts Journal*, v55, 72-85.

Liang, B. (2001): “Hedge Fund Performance: 1990-1999”, *Financial Analysts Journal*, v57, 11-18.

Loncarski,, I., J. ter Horst, and C. Veld (2007): “The Rise and Demise of the Convertible Arbitrage Strategy,” Working Paper.

Longstaff, F., S. Mithal, and E. Neis, (2005): "Corporate Yields Spreads: Default Risk or Liquidity? New Evidence from the Credit-Default Swap Market,” *Journal of Finance* v60, 2213-2253.

Lucas, R. (1978): “Asset Prices in an Exchange Economy,” *Econometrica*, v46, 1429-1446.

Malkiel, B. and A. Saha (2005): “Hedge Funds: Risk and Return,” *Financial Analyst Journal*, v61, 80-88.

Marquardt, C. and C. Wiedman (2005): “Earnings Management through Transaction Structuring: Contingent Convertible Debt and Diluted Earnings per Share,” *Journal of Accounting Research*, v43, 205-243.

Mayers, D.(1998): “Why Firms Issue Convertible Bonds: The Matching of Financial and Real Investment Options,” *Journal of Financial Economics*,v47, 83-102.

Merrill Lynch (2005): “Convertible Market Monitor,” May 2.

Mitchell, M. and T. Pulvino (2001): “Characteristics of Risk and Return in Risk Arbitrage.” *Journal of Finance*, v56, 2135-2175.

Pastor, L. and R. Stambaugh (2003): "Liquidity Risk and Expected Stock Returns", *Journal of Political Economy*, v111, 642-685.

Rubinstein, M. (1976): “The Valuation of Uncertain Income Streams and the Pricing of Options,” *Bell Journal of Economics*, v7, 407-425.

Santini, L., A. Macdonald, J. Range and A. Morse (2007): “Market’s Wild Ride Turns Hedge Funds Upside Down,” *The Wall Street Journal*, August 27, 2007.

Thomas, L. (2007): “Pack Mentality among Hedge Funds Fuels Market Volatility,” *New York Times*, August 13.

Urcan, O. and R. Kieschnick (2006): “Earnings Management and Convertible Debt Issuance,” Working Paper.

Chart 1
Cumulative Returns on Securities during Sample Period

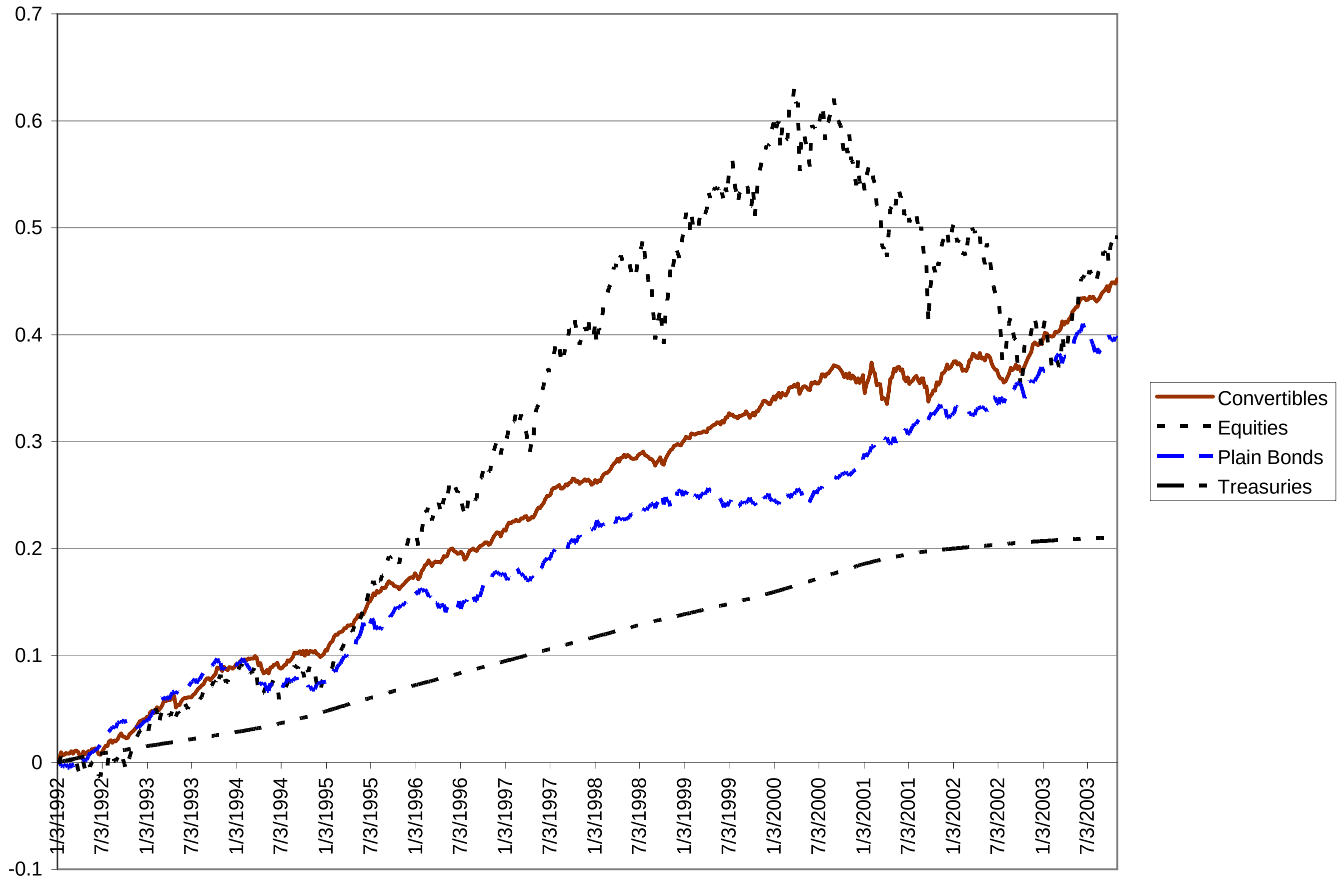

Table 1
Bond Summary Statistics

The following are 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.

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

Table 2
Borrower Summary Statistics

The following are 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.

Panel A. Total Assets		**Firm-Quarters**	**Mean**	**Median**	**25th%**	**75th%**	**SD**
Pre-1996	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
1997-2003	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**
Pre-1996	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
1997-2003	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**
Pre-1996	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
1997-2003	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

Table 3
Borrower Industry Breakdown

The following is 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.

		1992-1996			***1997-2003***		
Industries	NAIC Prefix	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%

Table 4
Complexity Metric Statistics

The following are 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.

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

Table 5
Portfolio Returns for "Long Equity of Complex Firms/Short Equity of Simple Firms"

The following are results from multi-factor equity time-series regressions over the 1992- 2003 sample period. The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(Mkt_t - R_{f,t}) + b_2(HML_t) + b_3(SMB_t) + e_1$, 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.

	Alpha	Rm-Rf	SMB	HML	UMD	Adj.R^2
Complex	-3.61%	1.12	0.01	-0.06		0.9182
	-2.65	*50.19*	*0.35*	*-1.00*		
	-2.68%	1.13	0.02	-0.06	-0.05	0.9164
	-1.80	*44.62*	*0.57*	*-1.18*	*-1.63*	
Simple	0.39%	0.96	-0.24	0.25		0.9499
	0.54	*58.98*	*-8.98*	*6.91*		
	0.03%	0.96	-0.24	0.26	0.01	0.9487
	0.04	*52.04*	*-8.16*	*7.06*	*0.48*	
Hedge-All Convertibles	-3.99%	0.17	0.25	-0.30		0.4168
	-2.20	*4.73*	*4.74*	*-3.56*		
	-2.72%	0.16	0.26	-0.32	-0.07	0.4278
	-1.29	*4.00*	*4.24*	*-3.78*	*-1.18*	
Upper quartile (UQ)	-4.30%	1.18	0.13	0.01		0.9026
	-2.61	*40.61*	*2.66*	*0.13*		
	-3.03%	1.17	0.12	-0.04	-0.12	0.9084
	-1.95	*35.96*	*2.34*	*-0.74*	*-3.71*	
Lower quartile (LQ)	1.14%	1.00	-0.25	0.25		0.9099
	1.04	*52.64*	*-7.85*	*5.51*		
	0.79%	1.01	-0.24	0.27	0.02	0.9089
	0.62	*49.72*	*-7.04*	*6.08*	*0.69*	
Hedge - UQ-LQ	-5.38%	0.18	0.39	-0.24		0.3768
	-2.49	*4.28*	*5.52*	*-2.41*		
	-3.79%	0.15	0.36	-0.31	-0.14	0.4034
	-1.63	*3.20*	*4.73*	*-3.61*	*-2.42*	
Weighted upper quartile (WUQ)	-4.54%	1.15	-0.09	0.18		0.8336
	-2.28	*27.32*	*-1.92*	*2.91*		
	-3.05%	1.15	-0.08	0.17	-0.08	0.8342
	-1.54	*27.63*	*-1.87*	*2.78*	*-2.98*	
Weighted lower quartile (WLQ)	1.77%	0.99	-0.26	0.24		0.897
	1.33	*41.15*	*-7.54*	*5.13*		
	1.47%	1.00	-0.25	0.26	0.01	0.8957
	0.99	*38.06*	*-7.06*	*5.28*	*0.17*	
WUQ-WLQ	-6.20%	0.16	0.17	-0.06		0.1169
	-2.48	*2.80*	*2.78*	*-0.61*		
	-4.46%	0.15	0.17	-0.09	-0.09	0.1286
	-1.69	*2.50*	*2.67*	*-0.99*	*-1.90*	

Table 6
Portfolio Returns for "Long Convertible Bonds"

The following are results from multifactor bond time-series regressions over the 1992-2003 sample period. The time-series regression estimated is: $R_{p,t} - R_{f,t} = a + b_1(DEF) + b_2(TERM) + e_1$, 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.

	Alpha	**DEF**	**TERM**	**Rm-Rf**	**SMB**	**HML**	**UMD**	**Adj.R^2**
All Convertibles	4.43%	0.28	0.16					0.0107
	3.32	*2.29*	*2.34*					
	3.19%	0.04	0.03	0.24	0.08	0.03	-0.04	0.5703
	3.06	*0.46*	*0.52*	*10.40*	*4.05*	*1.10*	*-1.69*	
	3.27%			0.24	0.08	0.03	-0.04	0.5713
	2.97			*11.10*	*4.10*	*1.24*	*-1.72*	
	3.40%			0.23				0.5514
	3.90			*12.19*				
High Complexity	3.98%	0.34	0.20					0.0162
	2.84	*2.78*	*2.92*					
	2.58%	0.10	0.07	0.24	0.08	0.03	-0.05	0.5662
	2.38	*1.13*	*1.18*	*10.13*	*3.91*	*1.28*	*-1.86*	
	2.78%			0.24	0.08	0.04	-0.05	0.5606
	2.41			*10.94*	*3.97*	*1.50*	*-1.90*	
	3.07%			0.23				0.5382
	3.23			*11.79*				
Weighted High Complexity	3.23%	0.19	0.14					0.0202
	3.39	*2.46*	*3.24*					
	2.11%	0.04	0.06	0.15	0.08	0.07	-0.01	0.4580
	2.90	*0.56*	*1.49*	*13.49*	*6.61*	*4.33*	*-1.88*	
	2.21%			0.16	0.08	0.07	-0.01	0.4447
	2.95			*13.82*	*6.75*	*4.81*	*-1.15*	
	2.82%			0.13				0.4038
	4.06			*13.06*				

Table 7
Portfolio Returns for "Long Convertible Bonds/Short Equity of Complex Firms"

The following are 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: $R_{p,t} - R_{f,t} = a + b_1(DEF_{,t}) + b_2(TERM_t) + e_1$, 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, with a five-to-one hedge ratio between the long and short portfolios for all regressions. Newey-adjusted t-statistics are in italics below each coefficient estimate.

	Alpha	**DEF**	**TERM**	**Rm-Rf**	**SMB**	**HML**	**UMD**	**Adj.R^2**
Hedge-All Convertibles	4.00%	0.09	0.06					0.0007
	5.05	*1.02*	*1.11*					
	3.76%	0.03	0.04	0.01	0.08	0.04	-0.04	0.0615
	3.61	*0.33*	*0.73*	*0.43*	*4.58*	*1.32*	*-1.33*	
	3.84%			0.01	0.08	0.04	-0.03	0.0584
	3.41			*0.57*	*4.34*	*1.54*	*-1.25*	
	4.26%			0.00				-0.0013
	4.92			*-0.20*				
Hedge-High Complexity	3.56%	0.10	*0.08*					0.0052
	4.62	*1.30*	*1.57*					
	3.28%	0.06	0.07	0.01	0.06	0.04	-0.03	0.0446
	3.26	*0.72*	*1.23*	*0.28*	*4.28*	*1.43*	*-1.14*	
	3.41%			0.01	0.06	*0.05*	-0.02	0.0353
	3.13			*0.47*	*3.92*	*1.73*	*-1.01*	
	3.92%			-0.01				-0.0006
	4.54			*-0.36*				
Hedge-Weighted High Complexity	2.69%	0.02	0.04					0.0098
	3.20	*0.19*	*0.70*					
	2.74%	0.03	0.07	-0.08	0.10	0.03	0.00	0.3151
	3.27	*0.38*	*1.52*	*-4.88*	*7.04*	*1.45*	*0.09*	
	2.84%			-0.07	0.10	0.04	0.01	0.2847
	3.19			*-4.73*	*7.05*	*1.87*	*0.99*	
	3.48%			-0.09				0.2018
	4.11			*-8.17*				

Table 8
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
	0.89	*4.66*	*4.79*	*-3.63*		*-1.73*	
	5.31%	0.16	0.26	-0.33	-0.07	0.00	0.4282
	0.97	*3.89*	*4.26*	*-3.87*	*-1.18*	*-1.45*	
Hedge-High Complexity	-2.67%	0.18	0.39	-0.24		0.00	0.3759
	-0.42	*4.24*	*5.52*	*-2.42*		*-0.40*	
	2.85%	0.15	0.36	-0.31	-0.14	0.00	0.4031
	0.42	*3.12*	*4.75*	*-3.68*	*-2.42*	*-0.94*	
Hedge – Weighted High Complexity	-2.36%	0.16	0.17	-0.06		0.00	0.1158
	-0.39	*2.77*	*2.79*	*-0.62*		*-0.58*	
	-2.06%	0.15	0.17	-0.09	-0.09	0.00	0.1272
	-0.31	*2.47*	*2.67*	*-0.99*	*-1.90*	*-0.31*	

Table 9
Multifactor Asset Pricing Tests with Liquidity Risk Factor Proxy
Portfolio Returns for "Long Convertible Bonds"

	Alpha	DEF	TERM	Rm-Rf	SMB	HML	UMD	Volume	Adj.R^2
All Convertibles	5.97%	0.28	0.16					0.00	0.0093
	1.45	*2.29*	*2.34*					*-0.35*	
	3.64%	0.04	0.03	0.24	0.08	0.03	-0.04	0.00	0.5696
	1.38	*0.45*	*0.52*	*10.48*	*4.04*	*1.11*	*-1.69*	*-0.16*	
	3.73%			0.24	0.08	0.03	-0.04	0.00	0.5705
	1.45			*11.15*	*4.08*	*1.24*	*-1.71*	*-0.16*	
	2.40%			0.23				0.00	0.5508
	0.91			*12.18*				*0.36*	
High Complexity	4.31%	0.34	0.20					0.00	0.0146
	1.00	*2.78*	*2.92*					*-0.07*	
	2.31%	0.11	0.07	0.24	0.08	0.03	-0.05	0.00	0.5609
	0.82	*1.11*	*1.17*	*10.23*	*3.90*	*1.29*	*-1.86*	*0.09*	
	2.57%			0.24	0.08	0.04	-0.05	0.00	0.5599
	0.92			*11.01*	*3.95*	*1.51*	*-1.90*	*0.07*	
	0.86%			0.23				0.00	0.5379
	0.29			*11.79*				*0.71*	
Weighted High Complexity	6.46%	0.19	0.14					0.00	0.0207
	2.17	*2.45*	*3.23*					*-1.15*	
	3.86%	0.04	0.06	0.15	0.08	0.06	-0.01	0.00	0.4577
	1.78	*0.54*	*1.47*	*13.46*	*6.64*	*4.29*	*-1.88*	*-0.87*	
	3.82%			0.16	0.08	0.07	-0.01	0.00	0.4442
	1.66			*13.75*	*6.77*	*4.76*	*-1.14*	*-0.75*	
	4.54%			0.13				0.00	0.4034
	1.95			*12.97*				*-0.81*	

Table 10
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
	0.80	*1.02*	*1.11*					*0.67*	
	3.44%	0.03	0.04	0.01	0.08	0.04	-0.04	0.00	0.0599
	1.26	*0.33*	*0.72*	*0.43*	*4.56*	*1.33*	*-1.33*	*0.11*	
	3.44%			0.01	0.08	0.04	-0.03	0.00	0.0568
	1.25			*0.58*	*4.32*	*1.55*	*-1.25*	*0.14*	
	2.45%			0.00				0.00	-0.0023
	0.90			*-0.19*				*0.64*	
Hedge-High Complexity	1.44%	0.10	0.08					0.00	0.0045
	0.56	*1.30*	*1.57*					*0.81*	
	2.47%	0.06	0.07	0.01	0.06	0.04	-0.03	0.00	0.043
	0.93	*0.72*	*1.22*	*0.29*	*4.27*	*1.45*	*-1.14*	*0.29*	
	2.53%			0.01	0.06	0.05	-0.02	0.00	0.0338
	0.93			*0.49*	*3.91*	*1.75*	*-1.01*	*0.31*	
	1.83%			-0.01				0.00	-0.0013
	0.69			*-0.35*				*0.76*	
Hedge-Weighted High Complexity	3.14%	0.02	0.04					0.00	0.0082
	1.34	*0.19*	*0.70*					*-0.19*	
	5.05%	0.03	0.07	-0.08	0.10	0.03	0.00	0.00	0.3151
	2.08	*0.36*	*1.50*	*-4.93*	*7.04*	*1.41*	*0.10*	*-0.99*	
	4.93%			-0.07	0.10	0.04	0.01	0.00	0.2844
	1.89			*-4.78*	*7.04*	*1.82*	*1.00*	*-0.84*	
	4.87%			-0.09				0.00	0.2009
	1.84			*-8.18*				*-0.54*	