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SLOW MOVING CAPITAL

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ABSTRACT

We study three cases in which specialized arbitrageurs lost significant amounts of capital and, as a result, became liquidity demanders rather than providers. The effects on security markets were large and persistent: Prices dropped relative to fundamentals and the rebound took months. While multi-strategy hedge funds who were not capital constrained increased their positions, a large fraction of these funds actually acted as net sellers consistent with the view that information barriers within a firm (not just relative to outside investors) can lead to capital constraints for trading desks with mark-to-market losses. Our findings suggest that real world frictions impede arbitrage capital.

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Unlike textbook arbitrageurs who instantaneously trade when prices deviate from fundamental values, real world arbitrageurs must overcome various frictions. For example, they often invest other peoples' money, resulting in a principal/agent problem that is exacerbated in market downturns. Rather than increasing investment levels when prices dip below fundamental values, arbitrageurs may, in the face of capital constraints, sell cheap securities causing prices to decline further. As a result, mispricings can be large and can extend for long periods of time.

We first study the convertible bond market in 2005 when convertible hedge funds faced large redemptions of capital from investors. These redemptions led to binding capital constraints for many funds, resulting in massive bond sales, and in many cases, fund liquidations. These sales reduced prices of convertibles relative to fundamental values, especially around redemption dates. While the group of multi-strategy hedge funds who were not capital constrained increased its overall position, about half of these hedge funds actually acted as net sellers consistent with the view that information barriers within a firm (not just relative to outside investors) can lead to capital constraints for trading desks with mark-to-market losses. We document similar patterns in the convertible bond market around the collapse of Long Term Capital Management (LTCM) in 1998. When LTCM incurred large losses on macroeconomic bets, the firm was forced to liquidate large convertible bond positions. These sales led to depressed valuations of convertible bonds despite the fact there was little change in overall fundamentals. As a result, other hedge funds incurred large losses and were also forced to sell their convertible bond holdings. In both cases, it took several months for traders to increase their capital, or for better-capitalized traders to enter.

We also study merger targets during the 1987 market crash. Merger arbitrageurs buy shares of target firms following merger announcements, providing liquidity to shareholders who

choose to sell. The market crash and concurrently proposed anti-takeover legislation caused merger spreads (the difference between the acquirer's offer and the target price) to widen substantially, inflicting large losses on arbitrageurs. Data from Wall Street proprietary arbitrage desks show that Wall Street firms reduced their exposures by selling target stocks. Furthermore, numerous arbitrage funds and Wall Street trading desks were forced to cease operations. Even though the market rebounded and the proposed legislation was dropped, spreads remained wide for several months, arguably caused by capital withdrawals from the market as natural liquidity providers became short-term liquidity demanders.

Our findings do not support the frictionless economic paradigm. Under this paradigm, a shock to the capital of a relatively small subset of agents should have a trivial effect on security prices since new capital would immediately flow into the market and prices would be bid up to fundamental values. Rather, the findings support an alternative view that market frictions are of first order importance: Shocks to capital matter if arbitrageurs with losses face the prospect of investor redemptions (Andrei Shleifer and Robert W. Vishny (1997)), particularly when margin constraints tighten during liquidity crises (Markus K. Brunnermeier and Lasse H. Pedersen (2006)), when other agents lack both infrastructure and information to trade the affected securities (Robert C. Merton (1987)), and when agents require a return premium to compensate for liquidity risk (Viral Acharya and Lasse H. Pedersen (2005)).

I. Convertible Bond Arbitrage: Capital Redemptions in 2005

Convertible bonds (corporate bonds with a call option on the underlying shares) are a capital source for many firms. Corporate capital needs are often immediate, and are facilitated by convertible arbitrage funds which account for up to 75% of the convertible market. Because the payoff of a convertible can be nearly replicated using other traded securities, its fundamental

value can be inferred from the prices of those other securities. Convertible arbitrageurs transform the convertible bond into a security with much lower risk by short selling the underlying stock,[1] thereby reducing information asymmetries and allowing the firm to quickly issue the convertible.[2] In exchange for providing liquidity to issuing firms, convertible bonds are often issued at prices below fundamental value.

Post issuance, convertibles are illiquid and, likely for this reason, often continue to trade below fundamental values. Assuming correct hedging, convertible arbitrage has minimal fundamental risk and thus leverage is often used to enhance returns. The primary risk is that short-run losses can arise if the bond becomes even cheaper, a problem which is exacerbated by the risk of forced liquidation at such an inopportune time.

In early 2005 large institutional investors in convertible hedge funds began to withdraw capital, purportedly because of low returns generated in 2004. According to the Barclay Group, more than 20% of capital was redeemed from convertible arbitrage funds in the 1st quarter of 2005. To meet investor redemptions, hedge funds began to sell convertible bonds causing their prices to fall relative to their fundamental values. As a result, convertible hedge funds experienced negative returns which caused further investor redemptions and more selling. The Barclay Group reported that by the 1st quarter of 2006, assets managed by convertible arbitrage funds had fallen by half.

[1] The arbitrageur may also sell short risk-free bonds to hedge interest rate risk, sell short non-convertible bonds or buy credit default swaps to hedge credit risk, and sell stock options to hedge volatility risk.

[2] In 1990, SEC Rule 144A became effective allowing firms to issue securities to qualified institutional buyers (QIBs) without having to register these securities, thereby accelerating the capital raising process. QIBs are allowed to resell the securities in the secondary market to other QIBs, prior to their subsequent registration. In recent years, nearly all convertible bonds have been issued via the 144A market. The transaction time is usually one to two days from announcement to closing, and is often less than 24 hours. Issuing a convertible bond via the public market would take at least a month.

Figure 1 displays the market value of convertible bond holdings, obtained from quarterly SEC 13-F filings, by convertible arbitrage funds during the first quarter of 2004 through the third quarter of 2006.[3] We consider the reporting entity to specialize in convertible arbitrage if it is a hedge fund, and if more than 50% of its SEC13-F reported assets are held in convertible securities at the end of 2004. We include only those funds which have at least $100 million in convertibles at the end of 2004. The final sample contains 28 convertible arbitrage funds. These 28 funds owned approximately $40 billion of convertible bonds at year-end 2004, roughly 15% of the total U.S. convertible market.[4]

To estimate changes in the value of holdings caused by selling activity, we removed the effect of changes in individual bond values using returns from the Merrill Lynch All-Convertibles Index. The data confirm the steep decline in convertibles held by hedge funds: By the end of 2005, the sample of 28 funds had sold 35% (t-statistic = -2.75 under the null hypothesis of no change in holdings) of their convertible bonds, and by the 3rd quarter of 2006 they had sold 41% (t-statistic = -3.02).[5] This data understates the true decline in holdings as we are not able to locate 13-F filings for several funds which are known to have liquidated.[6]

The massive selling of convertibles caused prices to decline relative to theoretical values. To determine the impact of the sell-off, we analyze a dataset of 550 U.S. convertible bonds

[3] The SEC requires institutions with greater than $100 million in equity or equity-linked securities to report their holdings within 15 days after the end of each calendar quarter.

[4] Note that there are numerous small (e.g. less than $100 million in assets), and foreign convertible arbitrage funds that are not required to report holdings to the SEC and are therefore missing from the sample. Furthermore, although holdings by Wall Street's trading desks must be reported to the SEC, they are commingled with the firms' other holdings and it is therefore impossible to ascertain the trading desks' positions. Anecdotal evidence suggests that, like the typical convertible fund, the largest trading desks significantly reduced inventories during 2005. Of course, for every seller there is a buyer, so the net selling that we observe must correspond to net buying by investors whose holdings we do not observe. These may not be specialized in convertibles.

[5] Interestingly, the large hedge fund Amaranth Advisors sold more than half of its convertible book after convertibles reached their cheapest level in 2005, and instead expanded their energy trading which had been profitable. Amaranth lost $6 billion from energy bets in September 2006 and had to shut down as a result.

[6] Funds often report their holdings with the SEC under a different entity name than the fund name, thereby making it difficult to locate all of the funds, especially those which have liquidated and are no longer in business.

during 2005–2006. For each bond, the market price (obtained from various trading desks of Wall Street banks) is compared to the theoretical value calculated using a finite difference model that incorporates the terms of each bond, and the following inputs: (a) issuer stock price, (b) volatility estimates derived from historical volatility and implied volatility from the options market, (c) credit spread estimates based on credit default swaps, straight debt yields, investment bank estimates, and bond ratings, and (d) the term structure of interest rates. To mitigate the impact of outliers, we focus on the median discount of market price to theoretical value. We also limit the sample to convertible securities where the underlying stock price is at least 65% of the bond's conversion price since focusing on the more equity-sensitive part of the convertible universe mitigates errors associated with inaccurate credit spread estimates.

Figure 2 displays the median market price divided by the theoretical value from January 2005 through September 2006. Bond prices deviated significantly from theoretical values, reaching a maximum discount of 2.7% in mid-May 2005. Based on the historical distribution calculated over the 1985 – 2004 period, this is roughly 2.5 standard deviations from the average. It was the largest deviation from theoretical value since LTCM began liquidating its convertible portfolio in August 1998. As shown, the discount to theoretical value reaches maxima around the deadlines for investor redemption notices, namely 45 days before the end of June and 45 days before the end of December (which we confirm using daily data, not reported).

Figure 2 also shows that convertible hedge funds had returns of -7.2% during January-May 2005, as reported by the hedge fund indices. This negative return is roughly what would be expected by a 2.7% cheapening of bonds assuming a typical fund leverage of 3:1. The loss could be caused in part by imperfect hedging, but we estimate that this effect is small since volatility and credit spreads changed little over the period. The fact that bond prices dropped significantly

without changes in fundamentals is consistent with the view that the price drop was driven by redemptions from convertible funds. Moreover, convertible prices rebounded in 2006, providing further evidence that 2005 losses were driven by capital flows and not by deteriorating fundamentals.

The deviation of convertible bond prices from theoretical values provided a seemingly profitable opportunity for multi-strategy hedge funds, whose stated advantage is their ability to quickly allocate capital across strategies depending on attractiveness. To determine whether multi-strategy funds increased their exposure to convertible bonds in 2005, we examined funds that invest in convertible bonds, but where convertible bonds represented less than 50% of their portfolios at the end of 2004. Requiring some ownership of convertible bonds is intended to identify those funds that have the necessary infrastructure to provide liquidity to the selling funds on a timely basis.

As shown in Figure 1, multi-strategy funds eventually began to invest in convertible arbitrage, but not until well after the 1st quarter 2005 sell-off. In fact, in response to negative returns, two large multi-strategy funds reportedly replaced their convertible trading staffs. Other multi-strategy hedge funds may have been waiting for bonds to cheapen further before increasing investment levels, especially in light of numerous reports at the time of entire portfolio liquidations. For the sample of 27 multi-strategy funds which have convertible holdings, we show that they increased their holdings by 36% and 18% by the end of 2005 and the 3rd quarter of 2006, respectively.[7] However, this increase is largely driven by one of the 27 multi-strategy funds; more than half of the funds actually reduced their exposures between the end of 2004 and the 3rd quarter of 2006.

[7] We also examined the holdings of large multi-strategy funds which did have any convertible holdings as of the end of 2004 and found that these funds did not purchase material quantities of convertible bonds in 2005.

Other natural buyers of convertibles are convertible mutual funds. From the CRSP Mutual Funds Database, we examined 16 convertible mutual funds which had at least $100 million in net-asset-value at the end of 2004. As shown in Figure 1, these funds experienced minor investor redemptions in 2005 and, since they are unable to employ leverage, mutual funds became forced sellers rather than natural liquidity providers.

A phenomenon similar to 2005 occurred in 1998 following the LTCM crisis. When LTCM experienced large losses on macroeconomic bets, it was forced to liquidate investments across markets, even those in which fundamentals had not changed. As shown in Figure 3, LTCM's liquidation of its convertible bond portfolio caused bond prices to fall which in turn caused other hedge funds to sell their convertible holdings. Using a proprietary dataset, we examine a large portfolio of convertible bonds during the LTCM crisis. Employing a methodology similar to that used to examine the 2005 episode, we document that convertible bond prices fell dramatically, eventually reaching a discount to theoretical value of more than 4% (nearly four standard deviations from the historical distribution's average). As in 2005, it took several months before bond prices returned to more normal levels and equilibrium was restored.

II. Merger Arbitrage and the Stock Market Crash of 1987

Merger arbitrage is a strategy which seeks to capture the difference (deal spread) between the stock price of a target firm and the offer price by the acquirer. After a merger announcement, the target's stock price usually appreciates considerably (20-30%), but then trades at a small discount to the offer price until deal completion. Mutual funds and other investors that hold the target stock sell their shares soon after the announcement. By selling, they insure against losses in case the deal is not consummated. While the probability of failure is usually small, losses

conditional on failure can be large. Investors often lose the entire merger premium realized at deal announcement, and can even suffer additional losses if, following deal cancellation, the target stock trades below its pre-announcement price. By purchasing target shares after merger announcements, merger arbitrageurs provide insurance against deal failure.

In a cash merger, the arbitrageur buys the target stock and holds it until merger consummation with the expectation of realizing the difference between the offer price and the current price. In a stock merger, the arbitrageur sells short the acquirer stock to eliminate market risk. Given that the return can be locked in by the arbitrageur, and since the deal failure risk is typically idiosyncratic and thus diversifiable, merger arbitrage is viewed as a market neutral strategy. However, Mark Mitchell and Todd Pulvino (2001) find that mergers are more likely to fail in the event of severe market downturns and propose a non-linear asset pricing model to estimate the risk and return to merger arbitrage. They create a portfolio of merger arbitrage investments and document that in most months the merger arbitrage portfolio exhibits systematic risk close to zero, but in severely declining markets, the market beta of merger arbitrage increases to 0.50.

Figure 4 displays daily merger arbitrage median spreads and returns for a portfolio of merger deals involving U.S. publicly-traded targets during the crash of 1987. On October 1, 1987, the median spread for the sample of 107 ongoing merger deals was 3.3%. During the period October 14-16, the U.S. House Ways and Means Committee proposed legislation to ban leveraged buyouts and hostile mergers as analyzed by Mark Mitchell and Jeffry M. Netter (1989). By October 16, in response to the proposed legislation, the median deal spread had increased to 5.4%. During the stock market crash on October 19 and 20, 1987, the median spread increased to 9.7% and 15.1%, respectively, as the arbitrage community expected the

termination or revision of many of the ongoing merger transactions.[8] As shown in Figure 4, this dramatic increase in deal spreads caused severely negative returns to merger arbitrage portfolios.

Figure 4 also displays trading activity of 18 anonymous merger arbitrage desks from major Wall Street firms.[9] For the month of October 1987 (the only month for which the data was provided), we display net purchases as a percent of the total long portfolio value aggregated across the 18 trading desks. These desks owned more than 10% of the total value of takeover targets as of the beginning of October and thus were influential in setting deal spreads. During the October 1-13 period, the 18 desks were net purchasers of target shares. Beginning October 14, contemporaneous with the proposed anti-takeover legislation, the desks began to reduce their positions. They accelerated their selling on October 19 reducing their holdings by 6%, and then sold more than 12% of their positions on October 20th. Interestingly, these desks continued as net sellers every day during the remainder of the month, despite a 5% stock market rebound and an indication by Congress that the anti-takeover legislation proposal would be withdrawn. We believe that the continued selling pressure from the proprietary desks was caused by internal capital constraints that were likely imposed as a result of the large losses. Indeed, many proprietary merger arbitrage trading desks shuttered operations in the aftermath of the crash and several arbitrage funds also shut down.

Whereas merger arbitrageurs typically serve a function of providing liquidity to target shareholders, they instead became liquidity demanders resulting in a substantial dislocation in merger targets' stock prices. Because merger activity continued to be robust following the crash,

[8] Many NASDAQ stocks did not trade on October 19, and thus the October 20 spread better reflects the impact of the market crash on merger arbitrage.

[9] The data was collected at the request of Mitchell and Netter (1989) while at the SEC. The data are deemed by the NYSE to be confidential in their entirety and confidential treatment has been requested by the NYSE in a letter dated February 10, 1988, which has been filed pursuant to 17 CRF 200.83(e) with the Freedom of Information Act Officer at the SEC.

there was an opportunity for surviving desks and a few well-capitalized entrants to invest in merger target stocks at very attractive spreads (for example, Warren Buffet entered the merger arbitrage market for a brief period after the crash). These investors realized stellar returns over the next year, until capital flowed back into the market and arbitrage spreads returned to more normal levels.

III. Discussion: The Speed of Arbitrage

We document what appear to be major and persistent price deviations from fundamental value, suggesting that while arbitrage is reasonably fast when market participants are not capital constrained, it can be slow following major capital dislocations. Convertible arbitrageurs provide immediate liquidity to firms unable to raise cash efficiently via the equity or straight debt markets. In return, these arbitrageurs receive a premium for holding a security which is highly illiquid. Likewise, merger arbitrageurs provide immediate liquidity to investors seeking to sell target shares after a merger announcement, and in return, receive a premium for bearing deal failure risk. However, in situations where external capital shocks force liquidity providers to reverse order and become liquidity demanders, it can take months to restore equilibrium to the dislocated market. This is because (1) information barriers separate investors from money managers, (2) it is costly to maintain dormant capital, infrastructure, and talent for long periods of time, while waiting for profitable opportunities, and (3) markets become highly illiquid when liquidity providers are constrained and traders demand higher expected returns as compensation for this lack of liquidity. The result is that profit opportunities for unconstrained firms can persist for months. Given the relative ease of estimating deviations from fundamentals in the convertible and merger markets, the time required to restore equilibrium is likely to be longer in other markets. We view our results as evidence that real world frictions impede arbitrage capital.

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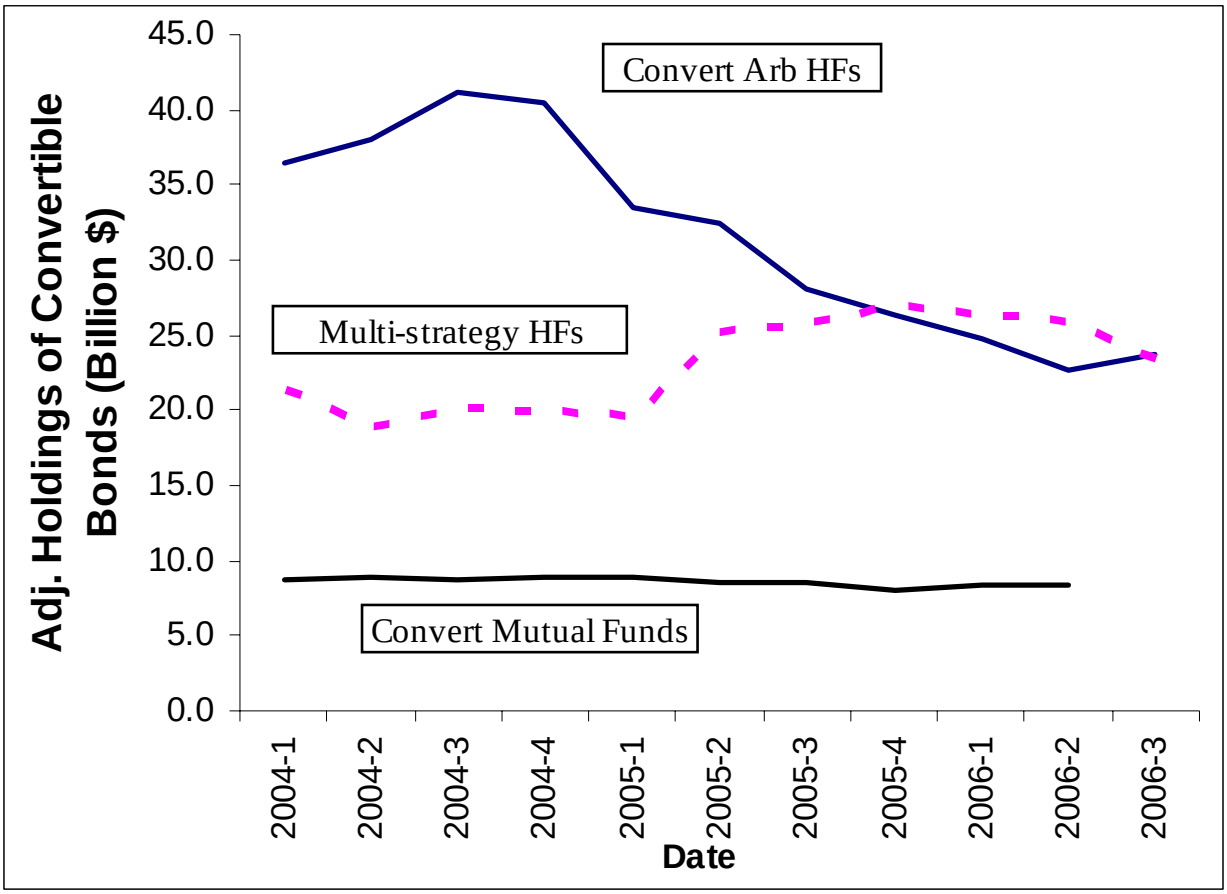

Figure 1. Adjusted Holdings of Convertible Bonds in Billions of Dollars.

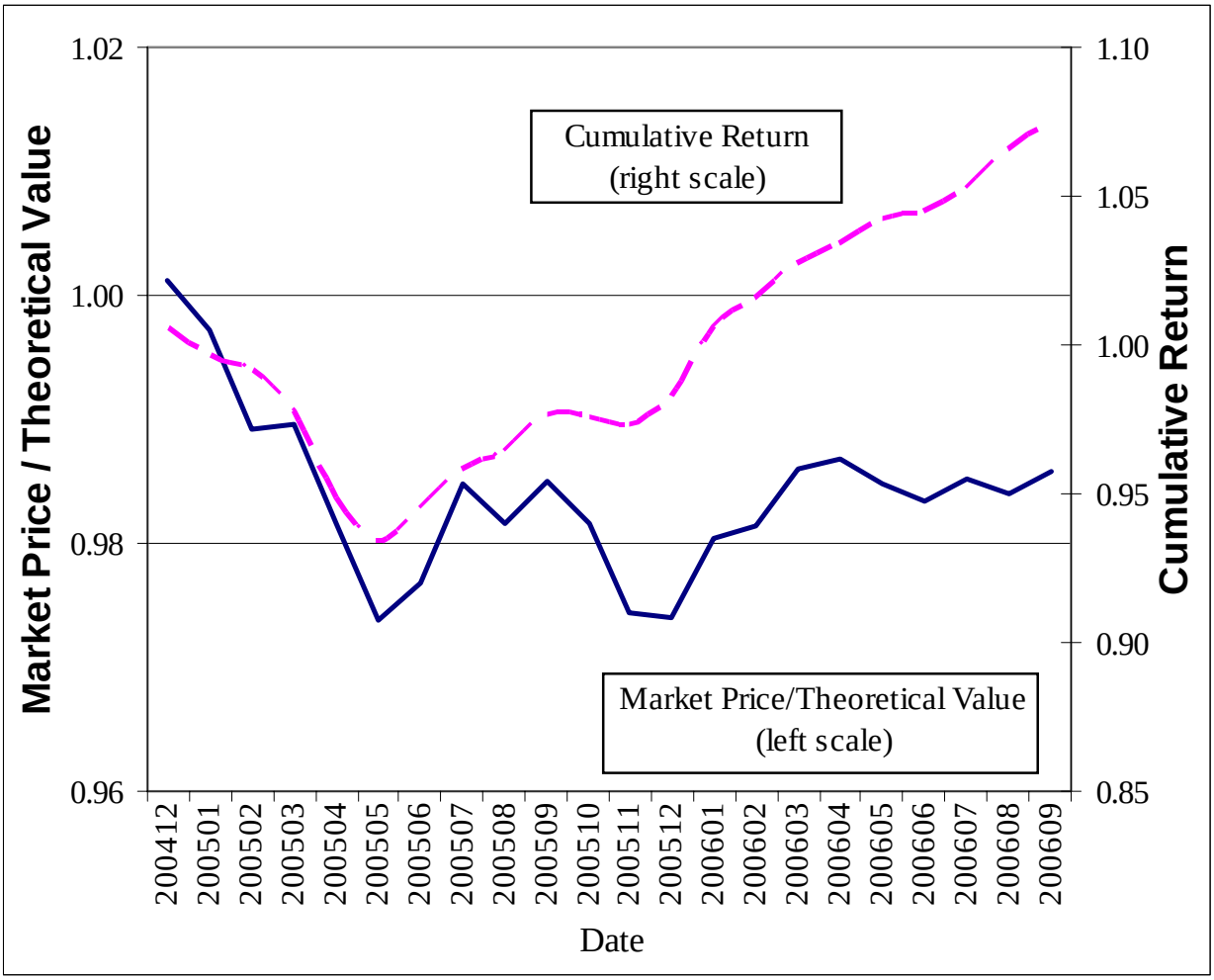

Figure 2. Price-to-Theoretical-Value of Convertible Bonds, and Return of Convertible Bond Hedge Funds, 2004/12-2006/09.

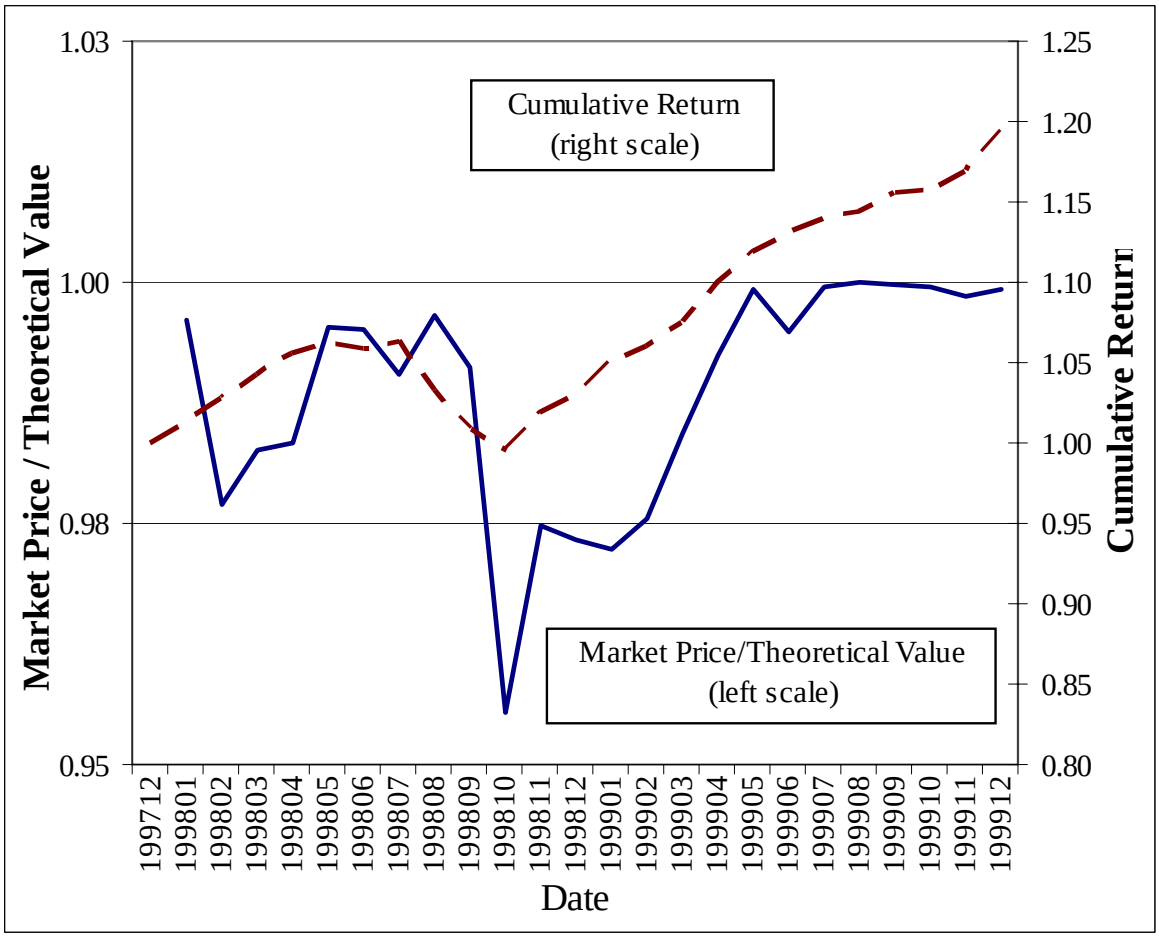

Figure 3. Price-to-Theoretical-Value of Convertible Bonds, and Return of Convertible Bond Hedge Funds, 1997/12-1999/12.

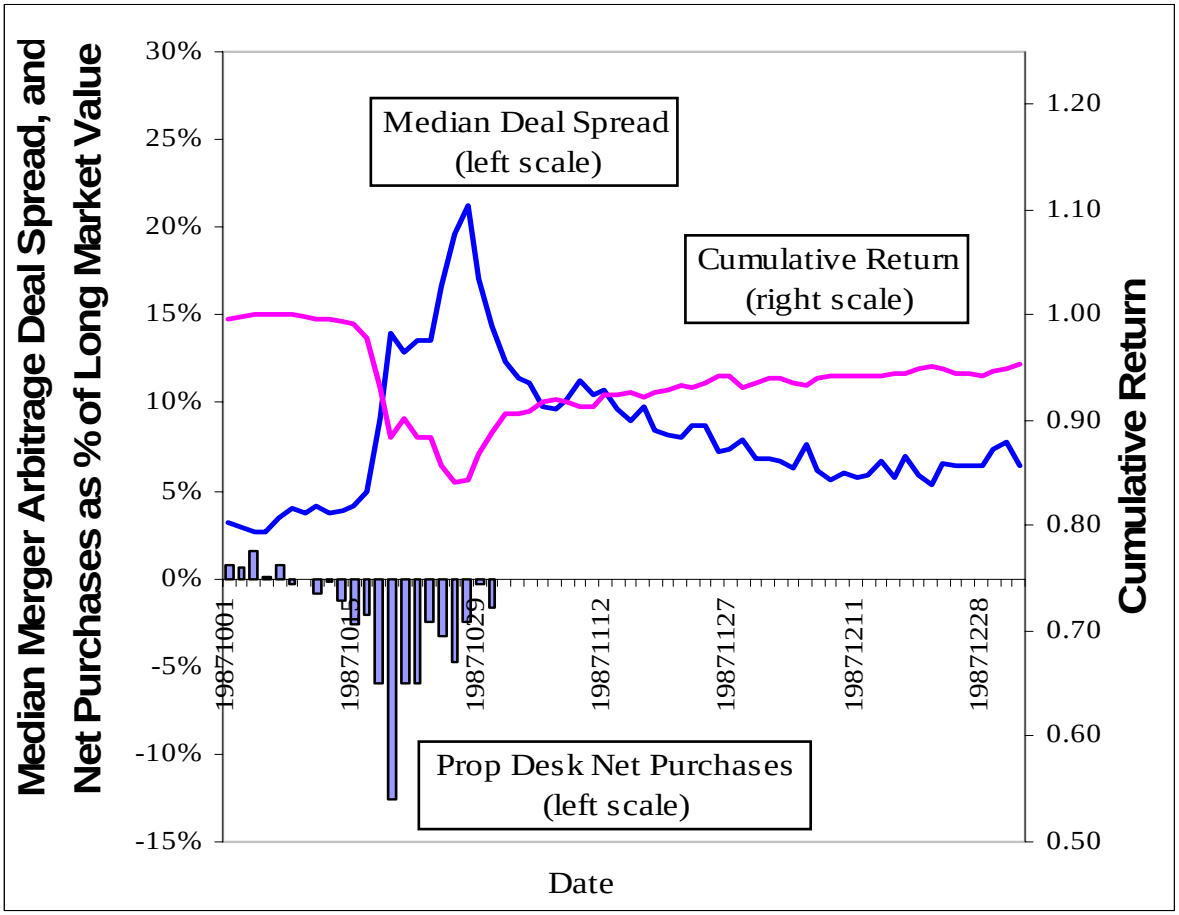

Figure 4. Merger Deal Spreads, Merger Arbitrage Returns, and Net Purchases by Merger-Arb Proprietary Traders.