I. Introduction

Convertible Bonds are fixed-income instruments that can be converted into shares of the issuer if the investor decides to exercise the option. They have the advantages of debt instruments in that it pays fixed coupons and can be redeemed at expiration at either par value or for a fixed number of shares, known as the conversion value. Conversion rights enable the investor to pick between the higher of redemption value or market value of underlying share. This enables investors to profit from a price increase in the underlying equity. The downside to investing in convertibles is that the issuer runs the risk of diluting the earnings of common stock and at the same time provide opportunities for large investors to take control of the company.

The U.S convertible market was estimated to be at US$252.8 billion in October 2005\(^1\) with most issues rated below investment grade or not rated at all. Demand for convertibles has grown enormously over the past two decades with companies and investors becoming more familiar with the benefits of convertible bonds, the trend can be expected to continue. As the convertible market develops and matures, the main players will continue to research and explore new ways to profit from these instruments.

<table>
<thead>
<tr>
<th>Credit Rating</th>
<th>Market Cap (US$ Billion)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>0.7</td>
<td>0</td>
</tr>
<tr>
<td>AA</td>
<td>15.1</td>
<td>6</td>
</tr>
<tr>
<td>A</td>
<td>32.8</td>
<td>13</td>
</tr>
<tr>
<td>BBB</td>
<td>53</td>
<td>21</td>
</tr>
<tr>
<td>BB</td>
<td>35.3</td>
<td>14</td>
</tr>
<tr>
<td>B</td>
<td>42.9</td>
<td>17</td>
</tr>
<tr>
<td>C</td>
<td>17.6</td>
<td>7</td>
</tr>
<tr>
<td>Not Rated</td>
<td>55.4</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>252.8</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

Some examples of market participants are:

**Underwriting Banks**
This is the initial issuing stage of the convertible where an investment bank and/or hedge fund underwrite the issue and take the placement risk by warehousing the debt instrument. They approach potential investors, usually institutions and hedge funds to place the debt. Profits for underwriting and placement come in the form of fees generated by the transactions.

**Long-only Investors**
Generate above average returns by investing in convertible bonds to capture the potential capital gains on price appreciation and interest income. Some studies have shown that Convertible Bond only portfolios have outperformed traditional 50% stock – 50% bond portfolios as well as all equity portfolios, on a global basis, between 1993 and 2000\(^2\).

\(^1\) Source: “Convertible Monthly,” Merrill Lynch Global Convertibles Research Group
\(^2\) Source: “Convertible Bonds: An Introduction to the Asset Class,” RMF Investment Products
**Equity Investors**
Equity investors are generally interested in capturing the upside potential of equity prices. They can purchase the convertible bond deep-in-the-money and capitalize on the equity gains, while generating income from the coupon on the bond. This coupon can generally be higher than the dividend payable to the investor for owning the stock. Equity investors can add exposure to the equity markets using convertible bonds without directly buying the underlying stock.

**Fixed Income Investors**
They typically buy convertible bonds deep-out-of-money, trading with yields close to their corporate counterparts, and capitalize on the upside potential of the underlying share price and fixed income coupon payments.

**Hedge Funds**
Convertible bond arbitrage is a strategy executed mostly by hedge funds. This involves going long the Convertible Bond and shorting the underlying stock according to the calculated delta-hedge. The strategy is successful because as the equity declines, the convertible bond begins to behave more like a traditional bond limiting the downside, while holding the stock short allows the hedge fund to capitalize on the price decline of the stock. If the equity price rises, the bond becomes more equity like and appreciates in price as the stock price increases. It is estimated that convertible arbitrage hedge funds account for approximately 60 - 75% of the market activity.³ Many of the funds trading an arbitrage strategy have become more tolerant to credit, interest and volatility risk. Historically, hedge funds that engage in convertible arbitrage typically finance their strategy and portfolios using a 5 to 1 leverage ratio, financing $5 for every $1 of capital. However, the average leverage for this strategy in 2004 was two times the capital.⁴

The market for Convertible Bonds is more liquid during periods when the demand is high for the instruments. The size of the offering also impacts the liquidity of the bonds. The average offering has been approximately US $270 million in the United States.

**II. Types of Convertible Bonds**

- **Vanilla Convertible Bonds**: bonds that can be converted into shares of the issuer, at a predetermined rate. Certain restrictions may apply as to if they become eligible for redemption.
- **Convertible preferred stock**: is similar in valuation to a bond, but with lower seniority in the capital structure. Non-payment of income is generally not regarded as an act of default by the issuer. The terms of each issue will define whether or not entitlement to unpaid preference income is cumulative.
- **Mandatory Convertible/Exchangeable Bonds**: are issued with shorter durations and higher yields than those offered by holding the common shares and must be converted upon maturity into equity, usually at a specified fixed ratio. To protect the issuer, the conversion price can be stipulated to be that at which the stock trades at the date of maturity.
- **Contingent Convertibles (Co-Co’s)**: are only convertible once the price of the stock is a

³Source: AIMA Canada Strategy Paper, September 2006, Number 6
⁴Source: AIMA Canada Strategy Paper, September 2006, Number 6
certain percentage above the conversion price for a specified amount of time – for example: trade for 20 days above contingent value out of 30 days. Issuers often favored using Co-Co’s because these shares are often not included in “Diluted EPS” unless they were trading above the contingent conversion price.

III. Payoff Profile

Parity line (stock price track) is the value to be received once the bond is converted; normally it’s the lower boundary price of the convertible security. Thus, if share price increases, the parity line or value will rise as well. The relationship between shares and bonds becomes stronger as the share price increases until “the bond price behavior and risk profile resemble characteristics of the underlying equity.” However, the bond’s sensitivity to the underlying share price will decrease if share price starts to fall, exhibiting price behavior such as those of regular bonds. As debt instruments, convertible bonds face the risk of default by the issuer with respect to the coupon, or the principal amount at maturity (represented in the graph as the steep fall on the left-hand-side).

Yield instrument (out-of-the-money)
Convertible bonds where the underlying share price trades much lower than conversion price, low equity sensitivity, and act as fixed income securities.

\[
\text{conversion price} > \text{equity price}, \text{within the area of debt}
\]

Hybrid instrument (at-the-money)
The underlying share price trades close to conversion price and their asymmetric payoffs are considered balanced. The bonds have medium sensitivity to changes in shares price, but are affected by volatility movements, interest rates and credit risk.

\[
\text{conversion price} = \text{equity price}, \text{within the area of equity & debt}
\]

Equity alternative (deep-in-the-money)
These convertible bonds have an underlying share price trading much higher than the conversion price, with very high sensitivity to changes in equity, but low in interest rate and credit risk. These bonds will always be converted and trade at a small premium or small discount to parity.

\[
\text{A contingent convertible with a $20 stock price at issue, 20% conversion premium and a contingent conversion trigger of 120%, can be converted (at $24) only if the stock trades above $28.80 ($24 \times 120%).}
\]
IV. Convertible Bond Arbitrage Strategy

The basis of the convertible bond strategy has its roots in an arbitrage method that was first used in the 1950s. Edward Thorpe, professor of mathematics and Sheen Kassouf, professor of economics at the University of California Irvine devised a mathematical strategy that would allow them to consistently make money on the market, regardless of market conditions. They employed the use of shorting common shares of a stock, purchasing warrants and selling short expiring warrants with the use of a margin account. Through statistical modeling using the computers available the duo were able to double their investments over the course of four years, while carefully fine-tuning and documenting their strategy. Some of the most notable quants of recent decades such as Ken Griffin of Citadel, Cliff Asness of AQR Capital, peter Muller of Morgan Stanley and Paul Wilmott of Oxford University to name a few, have read Thorpe’s book and devised various models in an attempt to beat the market.

The strategy currently involves arbitrageurs, usually hedge funds or proprietary trading desks at investments banks, looking to exploit inefficiencies in the pricing of convertible bonds by purchasing the undervalued convertible security and hedging their equity and market risk using the underlying shares and credit derivatives. The basic strategy is to take a long position in the convertible bonds and simultaneously sell short the underlying stock, essentially passing on the risk of owning a convertible bond to the equity market, also called delta-hedging the equity risk. This leads to the creation of the delta-neutral hedge long volatility position, which captures both income and volatility. Though the hedge neutralizes equity risk, it is still subject to interest rate and volatility risk.

Income can be generated from the coupon payments of the convertible bonds, and the accrued interest payments on the short position in the underlying stock. However, cash outflows can result from the cost of borrowing the underlying stock, and any dividend payments that are payable to the lender of the underlying stock.

This arbitrage opportunity exists due to the following key factors:

- Owing to the perception that the acquired securities are currently undervalued, selling short the equity associated with the underlying company further helps strengthen the position of the investor. As the perception is corrected, the investor is left holding securities whose value increases from the time of the purchase. If the equity does not increase, the losses will mostly still be limited on the downside.

- The long-only convertible market systematically undervalues the equity call option. Since most of the ‘new issues’ tend to be undervalued, hedge funds target them to be the strategy’s key return drivers.

The analysis of a typical convertible arbitrage trade involves the following three steps:

- Convertible bond arbitrageurs often look for undervalued convertible securities with good liquidity. Other key features investors seek, depending on their strategy, are low-premium bonds, i.e. convertibles that trade close to, if not, well through their conversion value; or bonds with high Sharpe (reward to risk) ratio.

- Establish the hedge ratios: A hedge ratio is basically a ratio “comparing the value of a

---

6 Hutchinson, pg6
position protected via a hedge with the size of the entire position itself.”

Investors using the “Cash-and-Carry” strategy must calculate the correct hedge ratio, i.e. the amount of shares to be sold short, so that their position can become profitable if the stock rises or falls.

- Manage the risks associated with the strategy.

V. Approaches to Convertible Arbitrage Trading

Cash-and-Carry Trading
Usually has a high hedge ratio (number of stock sold short against convertible bonds). Here, the manager focuses on low-premium bonds that are at the ‘equity stage.’ Leverage is the largest contributor to total return, with steady cash flows and the neutral delta-hedge ratio as the main drivers. Thus, the most profitable outcome is when the stock price falls. (See Exhibit A)

Volatility Trading
Hedge ratio is constantly changed in response to the stock’s implied volatility and/or the position’s potential gamma. Leverage contribution here is low. This is traded in the ‘hybrid’ stage as traders can assess and accept residual risks and calculate how much to pay for hedges (especially credit risk and interest rate risk).

Credit Trading
These bonds have a high default probability with the option being out-of-the-money. The focus is between the CB (senior security) and the share (junior security), where issuer is in financial distress.

VI. Risks Associated with Convertible Arbitrage

Credit Risk
Credit Risk is defined as the risk of a loss due to a credit event that causes the debtor to default on interest and/or principal payments. Most convertible bonds are issued below investment grade and some are not rated at all so the risk of default is significantly high. With the financial engineers constantly developing new financial instruments, managers can use other derivative instruments such as credit-default swaps (CDS) to hedge against default. However, the use of other derivatives such as a CDS introduces counterparty risk.

Market Risks
This risk is defined as the risk of a loss due to changes in market conditions such as interest rates, credit spreads, bond prices, commodity or equity prices, or asset volatilities. To control for these factors managers must generally develop comprehensive risk management strategies to limit exposures and monitor market exposure. Managers can use a variety of derivatives to mitigate the risks of these factors such as sutures, forwards, and swaps.

Basis Risk
Since hedge funds generally hold a large portion of convertible bonds, there is a potential for a highly correlated price decline in this asset class in periods of market downturns, including the lack of liquidity, forcing convertible bond prices to depreciate together. The illiquid state of the

---

7 Investopedia.com
8 AIMA Canada Strategy Paper, September 2006, Number 6
market can have an adverse effect on the strategy since this environment creates an inability to effectively liquidate the assets at proper valuations. The need to quickly liquidate and cover short positions can come at high cost if bonds are sold at depressed prices, and there is a flight to cover on the security by other hedge funds implementing similar strategies using the same instruments.

*Call Risk*
Though convertible bonds can be issued at a discount due to their low credit ratings, call risk arises when the bonds begin to trade at a premium. Once investors purchase a bond at a premium, there is a call risk if the bond is callable at par. However, as interest rates rise, the callable feature becomes less of a risk.

*Leverage*
We have recently witnessed the impact that too much leverage can have on a portfolio. While it can magnify gains, it can also magnify losses, triggering a sudden unwinding of positions and setting off a decline in assets in the same class, such as that described in basis risk.

*Liquidity and Execution*
Managers must be able to enter and exit positions without having an impact on the market as it will directly affect profits and losses. Of importance is the ability to short the stock effectively using the proper delta-hedge – the shares are borrowed at cost-effective rates and sold short in the market with ample liquidity. Again, liquidity plays an important role in executing the strategy because it allows managers to quickly enter and exit positions.

**VII. Alternatives to Effectively Hedge or Implement the Strategy**

While the uniform way to hedge a convertible arbitrage strategy is to use the natural delta-hedge, there other ways to implement the strategy and/or hedge a position. As we researched this area of assets, not much information is available on the use of derivatives by hedge funds to implement a convertible bond arbitrage strategy. This would involve using both over-the-counter and exchange-traded derivatives such as options, swaps, futures, and forwards. While some of these can add to the costs of executing the strategy and lowering returns, they can protect the downside of the investment and/or add to the returns with proper due diligence, financial modeling, proper execution, and risk management.

*Options*
The simplest way to use options is by using call and puts on the equity to enhance the return characteristics of the strategy. If a manager is looking to execute the convertible bond arbitrage strategy and take advantage of the upside potential of both the equity and the bond, he/she can buy calls on the equity in an attempt to capture the increase in the equity price. To help offset the cost of buying the call options, the manager can write out-of-the-money puts, since he expects these to not be exercised against him.

To decrease the amount of capital needed to implement the strategy, managers can also buy put options instead of shorting the equity, limiting their loss in a potential run up in the equity. However, this strategy is only successful if the options are highly liquid, helping to offset any sudden price movements. The high volatility that results with market downturns can effectively protect the convertible bondholder holding put options on the equity.

*Swaps*
To help alleviate the risk of interest rates, market upturns/downturns, credit risk, and currency risk (if implementing a strategy using foreign bonds such as Japanese convertible bonds), managers can use swaps to mitigate risks and/or attempt to capture more upside/downside momentum. Swaps play an important role in mitigating interest rate risks if the issuer can only issue the bonds with a floating rate and/or the hedge fund can access cheaper sources of funding by borrowing on a floating rate basis.

If the hedge fund seeks to invest in convertible bonds on a floating rate basis but the issuer only has fixed-rate bonds, the hedge fund manager can seek out an intermediary to sell the fixed-rate convertible bonds with a swap attached that converts the fixed-rate coupons into LIBOR floating rate coupons. This is contingent on the fact that the hedge fund can extract an economic benefit by entering into such a transaction.

Credit-Default Swaps can also be used to mitigate the risk of default by a convertible bond issuer and/or increase the return of the strategy. If the manager seeks to protect his portfolio from any downside or default on the bond, he/she can purchase a CDS on the bond. If the manager has done the proper due diligence and expects the credit quality of the issuer to improve, he/she can capitalize on the credit spreads by selling a CDS on the convertible bond and collecting a premium, adding to the return components of the strategy. However, further exposure to the downside on a convertible bond may force the hedge fund to liquidate as the protection buyer exercises the CDS, forcing a payment on default.

Other resources available to managers come in the form of CDS Indexes, which are highly liquid because they are comprised of the most liquid credit references. Some of these indexes include the DJ CDX indexes for North America and Emerging Markets, and the DJ iTraxx credit indexes that track Europe and Asia. As of recent, two indexes were introduced by The Markits: The Markit iBoxx Liquid USD Convertible Bond Index ("CVBX"); and The Markit iBoxx Liquid USD Delta-Hedging Stock Index ("CVEX"). These are the first indexes to cover the convertible arbitrage market by using an index to offer exposure to both the bonds and the stocks. They are created every six months and mature in two years. The CVBX references 100 convertible bonds and the CVEX references the 100 underlying equities in an equally weighted. With the introduction of these indexes, managers can implement the strategy using a total return swaps on both the CVEX and the CVBX.

VIII. Portfolio Success Implications

Convertible bond arbitrage has consistently provided attractive returns to those who have the proper resources to effectively execute the strategy. The indexes used to bench market the strategy are Credit Suisse/Tremont Convertible Bond Hedge Fund Index (CS/T Index), Hedge Fund Research, Inc. RV: Fixed Income-Convertible Arbitrage Index (HFRI – Convertible Index), and the Merrill Lynch All US Convertibles Index (ML – Convertible Index). The CS/T Index and HFRI – Convertible Index offer a wealth of information with respect to monthly returns, correlations, Sharpe-ratios, and maximum drawdown of hedge funds executing convertible arbitrage strategies.

According to monthly returns published by the Credit Suisse/Tremont Convertible Bond Hedge

---

9 Eric, Glanz, Siegel: Credit Derivatives
Fund Index, convertible arbitrage exhibits less volatile monthly returns when compared to the S&P 500, with most observations falling between 0.015% and 3% returns, since 1994, the year they began compiling the information. The majority of monthly returns were 1.5%, observed nearly 100 times. The only time convertible arbitrage and the S&P 500 experienced positive correlations came during the market downturn of 2008, where all assets were highly correlated as managers and investors sought to unwind positions. This created a maximum drawdown of nearly 60% on convertible arbitrage portfolios.

In his convertible bond arbitrage study, Mark Hutchinson found evidence that “the convertible bond arbitrage returns are positively correlated with equity markets in severe downturns and negatively correlated with equity in severe upturns.” In other words, the daily returns from an equally weighted convertible bond arbitrage portfolio would be negatively correlated to equities in severe market upturns, or the convertible bond arbitrage portfolio will move in the opposite direction of an equally weighted equity portfolio. In fact, we can say that the convertible bond arbitrage can be said to be similar to issuing naked out of the money put and call options, i.e. when the strike price is higher than the prevailing market price of the stock for calls, and when the strike price is lower than the market price for puts. So, in effect, this would be suitable for investors who are expecting a larger move in the price of the underlying asset. Due to the higher amount of risk involved, the profits and losses experienced are also larger. (See Exhibit F for current market correlations)

While this strategy has proven to be successful, careful attention must be given when constructing convertible arbitrage portfolios and their impending risks. As it stands, the average asset allocation by hedge funds to this strategy has been around 2%, with a high of approximately 9% in 2003, versus approximately 26% for Event Driven strategies, and 22% for Long/Short strategies.

Many hedge fund managers have taken on Ed Thorp’s strategy and made substantial profits by implementing sophisticated mathematical models and information technology. However, one must beware of the risks associated with any investment and perform the proper due diligence before investing in any strategy. Once correlations go positive during major market downturns, even the most sophisticated mathematical models will break down, forcing a massive liquidation, and bringing even the biggest hedge fund powerhouses ran by the brightest minds on Wall Street, near a collapse.

Appendix

Exhibit A – Cash and Carry Trade Strategy

-----------------------  1. Purchase 1000 convertible bonds at 108.  -----------------------

11 Hutchinson, Mark, and Liam Gallagher. "Convertible Bond Arbitrage."
2. Manager makes initial capital investment of $202,500.
3. $877,500 is borrowed for a total investment of $1,080,000, or a leverage of 4 times capital.
4. Conversion ratio = 34.783
5. Sold Short 26,000 shares (Hedge Ratio of 75%)

<table>
<thead>
<tr>
<th>Return Source</th>
<th>Assumption</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond Interest Payment</td>
<td>Coupon = 5% on $1000 face value. Conversion value of 34.783 shares</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>Short Interest Rebate</td>
<td>1.25% Interest earned on 26,000 short shares. Hedge Ratio of 75% = 26,000/34783.</td>
<td>$8,653.00</td>
</tr>
<tr>
<td><strong>Less</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of Leverage</td>
<td>2% interest on $877,500 borrowed funds</td>
<td>($17,550.00)</td>
</tr>
<tr>
<td>Dividend Payment</td>
<td>1% dividend yield on $692,250</td>
<td>($6,922.00)</td>
</tr>
<tr>
<td><strong>Total Cash Flow</strong></td>
<td></td>
<td>$34,181.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arbitrage Returns</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond Return</td>
<td>Bought at 108 and sold at a Price of 120 $1,000</td>
<td>$120,000.00</td>
</tr>
<tr>
<td>Stock Return</td>
<td>Sold stock short at $26.625 and rose to $31.00</td>
<td>$113,750.00</td>
</tr>
<tr>
<td><strong>Total Arbitrage</strong></td>
<td></td>
<td>$6,250.00</td>
</tr>
<tr>
<td><strong>Total Return</strong></td>
<td></td>
<td>$40,431.00</td>
</tr>
</tbody>
</table>

Exhibit B – Return Contributions

<table>
<thead>
<tr>
<th>Sources of Return</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond Interest Income</td>
<td>4.60%</td>
</tr>
<tr>
<td>Short Rebate</td>
<td>0.80%</td>
</tr>
<tr>
<td>Dividend Payment</td>
<td>-0.60%</td>
</tr>
<tr>
<td>Cost of Leverage</td>
<td>-1.60%</td>
</tr>
<tr>
<td>Arbitrage Return</td>
<td>-0.60%</td>
</tr>
<tr>
<td><strong>Unlevered Return</strong></td>
<td>3.80%</td>
</tr>
<tr>
<td>Contribution from Leverage</td>
<td>16.20%</td>
</tr>
<tr>
<td><strong>Total Return</strong></td>
<td>20.00%</td>
</tr>
</tbody>
</table>

Exhibit C – Credit Suisse/Tremont Convertible Bond Arbitrage Index Monthly Returns Histogram
Exhibit D – S & P 500 Monthly Returns Histogram

Exhibit E - Credit Suisse/Tremont Convertible Bond Arbitrage Index versus the S & P 500 (Monthly)
Exhibit F – Credit Suisse/Tremont Hedge Fund Index Current Market Correlations

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Convertible Arbitrage</th>
<th>CS/T Index</th>
<th>S&amp;P 500</th>
<th>ML - US Convertible Index</th>
<th>DJWI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Suisse/Tremont Hedge Fund Index (CS/T Index)</td>
<td>0.53</td>
<td>1</td>
<td>0.54</td>
<td>0.69</td>
<td>0.6</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>0.35</td>
<td>0.54</td>
<td>1</td>
<td>0.79</td>
<td>0.93</td>
</tr>
<tr>
<td>Merrill Lynch All US Convertibles Index (ML - US Convertible Index)</td>
<td>0.55</td>
<td>0.69</td>
<td>0.79</td>
<td>1</td>
<td>0.84</td>
</tr>
<tr>
<td>Dow Jones World Index (DJWI)</td>
<td>0.42</td>
<td>0.6</td>
<td>0.93</td>
<td>0.84</td>
<td>1</td>
</tr>
</tbody>
</table>

Exhibit G – Assets Dedicated to the Strategy by Hedge Funds (Source: Credit Suisse/Tremont Hedge Fund Index)


