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Abstract

This paper analyzes convertible bond arbitrage on the Canadian market for the period 1998 to 2004. Convertible bond arbitrage is the combination of a long position in convertible bonds and a short position in the underlying stocks. Convertible arbitrage has been one of the most successful strategies of hedge funds. This paper shows that the convertible arbitrage strategy has considerable effects on capital markets. First, there is a downward pressure on cumulative average abnormal returns of the underlying stocks between the announcement and the issuance dates of convertible bonds. Second, short sales of the underlying equity around the issuance dates strongly increase for equity-like convertibles. Third, convertible bonds are underpriced at the issuance dates. All effects are stronger for equity-like than for debt-like convertible bonds. Finally, we find that over a one-year period following the issue, equity-like convertibles earn a return that is more than 23 percentage points higher than the return of debt-like convertibles. In the last years of our sample, convertible arbitrage returns have strongly decreased. This seems to be related to a shift from equity-like to debt-like convertibles by the issuing companies.

JEL codes: G12, G14, G24, G32

Keywords: convertible arbitrage, short sales, underpricing, convertible bonds, abnormal returns

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1 Introduction

It is empirically well documented that convertible bond issues have a negative wealth effect in Anglo-Saxon markets. Dann and Mikkelson (1984), Kim and Stulz (1992) and Lewis, Rogalski and Seward (2003), amongst others, found negative abnormal stock returns varying between –1.09 and –2.31% on the announcement day of a new convertible bond issue. Kang and Lee (1996) and Ammann, Kind and Wilde (2003) provide some evidence for the fact that convertible bonds tend to be underpriced. This underpricing provides potential arbitrage opportunities, and might attract the attention of hedge funds, amongst others, nowadays. Arshanapalli, Fabozzi, Switzer, and Gosselin (2004) mention that in the U.S. up to 70% of the issues of convertible bonds are bought by hedge funds. A similar proportion of around 75% is reported by Lian (2006). These hedge funds are potentially engaged in a convertible bond arbitrage strategy[1], where a long position is taken in the convertible bond and a short position in the underlying stock. In this way they try to exploit the mispricing in convertible bonds.

Convertible arbitrage trades currently represent more than half of the secondary market trading in convertible securities with hedge funds as the most important player in this market[2]. Convertible arbitrage has been one of the most successful hedge fund strategies at the end of the nineties and the beginning of 2000's. This paper studies the different effects that convertible arbitrage has on capital markets. More specifically, we examine the following four effects. First, we study the pattern of wealth effects between the announcement and the actual issuance date of the convertible bonds. Second, we examine the development in the short positions of the underlying stocks around and after the announcement of a convertible issue. Third, we examine whether convertible bonds are mispriced and how the mispricing develops over time. Finally, we investigate the determinants of convertible arbitrage returns. Our detailed study of the components of the convertible arbitrage returns will also shed some light on the question why these returns have decreased over the years.

Even though convertible bond strategies have received ample attention in the popular press, there is not much academic research on this phenomenon. This is remarkable, given the extent of this market. To the best of our knowledge, four papers have studied convertible arbitrage strategies in detail. In a simulation experiment, Arshanapalli, Fabozzi, Switzer, and Gosselin (2004) show that a convertible arbitrage strategy can be highly profitable, especially in down equity markets. Similarly, Henderson (2005) demonstrates positive excess risk-adjusted returns of convertible arbitrage strategies, in particular up to six months following the issue. Agarwal, Fung, Loon and Naik (2006) argue that abnormal returns of convertible arbitrage hedge funds are a liquidity premium, as hedge funds act as liquidity providers in the convertible bond market. Finally, Choi, Getmansky and Tookes (2006) examine the impact of convertible arbitrage on equity market liquidity and stock prices. They find evidence for arbitrage induced short selling,

[1] The term convertible bond arbitrage is misleading, since convertible arbitrage is never a real risk-free strategy. The complicated nature of the different options that are combined in a convertible bond, and given that it is a corporate bond, which by definition is risky, it is not possible to completely hedge this risk. However, given that this term is widely used in the hedge fund industry, we will also use it throughout this paper.

[2] See, Lhabitant (2002).

and this is significantly and positively related to liquidity improvements.

Our convertible arbitrage analysis leads to several findings. First, we observe persistent downward pressure on cumulative average abnormal returns between the announcement and issuance dates, with about 4 percentage points more negative returns for equity-like convertibles compared to debt-like convertibles. Ammann, Fehr and Seiz (2006) and Arshanapalli et al. (2004) examine the issue day effects of convertible bonds as well. However, they do not distinguish between debt-like or equity-like issues nor do they examine patterns in the short positions of the underlying stock.

Second, by using information on aggregated bi-monthly short positions on the Toronto Stock Exchange (TSX), we argue that the downward pressure on cumulative average abnormal returns is due to the activities of hedge funds or other investors that are engaged in convertible arbitrage (or hedging) strategies. Ackert and Athanassakos (2005) find a negative relationship between abnormal returns and short sales in the Canadian market, although this effect is weaker for companies that have convertible bonds outstanding. We observe significant increases in the short positions of the underlying stocks after the announcement of a convertible bond issue. In the 30 trading days following the announcement of the issue, the increases in relative short positions for equity-like issuers are about 25 percentage points higher than for debt-like issuers. These increased aggregated short positions remain stable after the issue of the convertible for a longer period of time. This indicates that hedge funds, or other participants, construct their position immediately after the announcement of a convertible issue, and keep the position for a longer period. The negative cumulative average abnormal returns and the long term changes in the levels of short positions, demonstrate a pattern in investment activities that is a characteristic of convertible arbitrage strategies.

Third, we examine the mispricing of convertible bond issues. Based on the valuation model of Tsiveriotis and Fernandes (1998) we find the equity-like issues about 25% underpriced, and the debt-like convertibles about 5% underpriced at the issue. The underpricing does decline somewhat immediately following the issue, but nevertheless persists over a longer period of time. We show that the trading volume (liquidity of the issue), the low investment grade, the size of the issue and the size of the equity component are potential explanations for the observed phenomena.

Finally, we investigate the determinants of convertible arbitrage returns. Immediately after the issue of a convertible, the degree of underpricing seems to drive the convertible arbitrage returns, as it decreases substantially in the first twenty trading days. Convertible arbitrage returns are about 23 percentage points higher for more equity-like convertibles than for more debt-like issues in a one-year period following the issue. The difference is attributable to the large returns on short positions in the underlying stock. It is obvious that the high returns that hedge funds make using convertible arbitrage come at the expense of the issuing companies. We find that over the years, convertible bonds have become more debt-like. We also show that the type of issuer is no longer the same. In later years, convertible bonds are issued by less risky companies compared to the earlier years. The change in convertible bond structures is the most likely determinant of the lower convertible arbitrage returns in recent years.

The remainder of the paper is structured as follows. In Section 2 we describe the notion of convertible arbitrage and the role of hedge funds. In Section 3 we describe our sample data. Section 4 is devoted to the analysis of wealth effects associated with announcement and issuance dates of convertible debt offerings. This is followed by the main analysis regarding the relationship between the mispricing, trading volume and short sales in Section 5. In Section 6 we analyze convertible arbitrage returns and provide some insights into the discussion regarding the reasons for their decline. Section 7 concludes.

2 Convertible Arbitrage and Hedge Funds

2.1 Convertible Arbitrage

The classical convertible arbitrage strategy involves taking a long position in a convertible bond and a short position in the underlying stock. Similar results can be achieved by warrant hedging (long position in warrant, short position in underlying stock), reverse hedging (short position in warrant, long position in underlying stock), capital structure arbitrage (a technique aimed at exploiting pricing inefficiencies in the capital structure of the firm), as well as with some other techniques (for more details see Calamos, 2005). In this paper we focus on the classical convertible arbitrage, since we explore the relationship between convertible arbitrage returns, the pricing of convertible bonds and short sales.

The beginnings of convertible arbitrage, albeit not as refined and computationally sound as today, go back as far as the second half of the nineteenth century, when the first convertible securities were being issued (Calamos, 2005). The "arbitrage" setup was based on the same principle as today - taking a long position in bonds and a short position in the underlying stock. The specific number of shares of common stock to be sold short is a function of the conversion ratio (number of stocks into which the convertible bond converts), the sensitivity of the convertible bond price to changes in the price of underlying equity (the so-called delta measure), and the sensitivity of the delta measure to the changes in the price of underlying equity (the so-called gamma measure).

The delta measure is defined as the change in the value of the convertible bond due to the change in the value of the underlying equity. It can be derived from the option pricing model of Black and Scholes (1973), adjusted for continuous dividend payments in the way suggested by Merton (1973):

$$\Delta = \frac{\partial B}{\partial S} \tag{1}$$

$$\Delta = e^{-\delta T} \cdot N\left[\frac{ln\frac{S}{K} + (r - \delta + \frac{\sigma^2}{2}) \cdot T}{\sigma \cdot \sqrt{T}}\right], \tag{2}$$

where B is the convertible bond price, S is the current price of the underlying stock, K is the conversion price, δ is the continuously compounded dividend yield, r is the continuously compounded yield on a selected "risk-free" bond, σ is the annualized stock return volatility, T is the maturity of the bond and N(.) is the cumulative standard normal probability distribution. The delta measure always takes a value between 0 and 1. Values closer to 1 indicate a high sensitivity of the convertible bond value to the underlying equity (stock) value, implying a high probability of conversion.

The convertible arbitrage strategy provides the following cash flows. First, cash inflows from coupon payments of the convertible. Second, cash inflows from the short interest credit on the short stock account[3]. Three, dividend payments on shorted stock lead to cash outflows. This is also the reason why non-dividend paying stock is more desirable for the strategy. Finally, if at the time of the arbitrage setup the convertible bonds are underpriced, there is a potential for arbitrage profits.

The hedge ratio and the convertible arbitrage setup are time varying, since they depend on the stock price. When the stock price approaches the conversion price, the delta of a convertible bond increases; since the bond becomes more equity-like (i.e. the price of the bond becomes more sensitive to the changes in the value of the underlying equity). This means that more stocks need to be shorted in order to maintain the neutral hedge ratio, which is defined as a product of the conversion ratio and delta. The opposite holds if the stock price goes down.

It should be noticed that the delta is not a perfect measure for the sensitivity of conversion option to changes in stock price. This is caused by the fact that the conversion option is in fact an option with a stochastic exercise price (since the underlying bond is used to pay for the exercise price). Besides that, convertible bonds are almost always callable, and sometimes also putable. In addition, the exercise of a conversion option leads to the creation of new shares. All these features are not captured in the delta measure. However, given the fact that there is no better variable available than the delta measure, we continue to use this measure as an indicator of the sensitivity of the conversion option to changes in the price of the underlying stock[4].

Calamos (2005) argues that convertible arbitrageurs in general look for convertible bonds that are more equity-like. The underlying shares have a higher volatility, which translates into a higher value of the equity option, a lower conversion premium and a higher gamma. Besides that, they have a preference for underlying stocks that pay low or no dividends, that are undervalued, liquid and that can be easily be sold short. Additionally, zero coupon convertible bonds or so-called LYONs (Liquid Yield Option Notes[5]) are said to be less desirable for convertible arbitrage, as they do not pay coupons and therefore lack cash inflows in the form of coupon components. For the purpose of this paper we look into a simple (stylized) setup of a convertible arbitrage, where a neutral hedge ratio is determined with the delta measure. We ignore any higher "Greeks" or moments in sensitivity of the convertible bond value with respect to changes in the value of

[3]The borrower of the stock (the party that short sells the stock) needs to keep a certain margin requirement with the broker where the shares were borrowed. This serves as a guarantee for the future return of the stock. This margin is typically about 50% of the value of the shorted stock. These funds are then credited with the short interest credit.

[4]For the same reason other studies use the delta measure as well; see e.g. Lewis et al. (1999).

[5]LYONs are zero coupon callable and putable convertible bonds.

the underlying equity. This provides us with a simple and intuitive framework for analyzing the relationship between underpricing, short sales and convertible arbitrage returns.

2.2 Convertible Arbitrage Hedge Funds

Convertible arbitrage has been one of the most successful hedge fund strategies of the end of the nineties and the beginning of 2000's. Using a survivorship free hedge fund dataset of Tass-Tremont, we find that the number of convertible arbitrage hedge funds grew from about 26 in 1994 to about 145 in May 2003. As of that moment the number of convertible arbitrage hedge funds dropped to about 126 in November 2004. In the same period the assets under management grew from about 0.7 billion in January 1994 (i.e. about 2.2% of the total assets under management in the hedge fund industry) to about 11.5 billion in May 2003 (i.e. about 2.8% of the total assets under management) and to 13.9 billion in November 2004 (i.e. about 1.9% of the total assets under management). The average annual return over the period 1994 - 2004 was 9.40% with an annual standard deviation of 4.66%. For comparison, during the same period the average annual return of the S&P 500 was 11.68% with a corresponding standard deviation of 15.24%. This indicates that the risk-reward trade-off for the convertible arbitrage strategy was much better than that of a pure equity strategy.

According to Lhabitant (2002), convertible arbitrage trades represent more than half of the secondary market trading in convertible securities. This indicates that hedge funds are a very important liquidity provider in the convertible market. Hedge funds differ from mutual funds and other investment vehicles by their lack of regulation, with limited transparency and disclosure, and by their internal structure (see Fung and Hsieh, 1997). Most hedge funds try to achieve an absolute return target, irrespective of global market movements, while hedge fund managers typically have incentive-based contracts. Accordingly, hedge funds have a broad flexibility in the type of securities they hold and the type of positions they take. On the other hand, investors in hedge funds are often confronted with lockup periods and redemption notice periods. Such restrictions on withdrawals imply smaller cash fluctuations, and give fund managers more freedom in setting up long-term or illiquid positions.

The non-standard features make hedge funds an interesting investment vehicle for investors with potential diversification benefits. From an investor point of view, it appears that a convertible arbitrage strategy offers a huge diversification benefit due to a low correlation between a convertible arbitrage strategy and a pure equity index like the S&P500. During the period 1994 - 2004 this correlation was about 0.126. Using a sample of convertible bonds issued by Japanese firms, Agarwal, Fung, Loon and Naik (2006) show that most of the return variation in convertible arbitrage hedge fund indices can be explained by three risk factors, i.e., the implied interest rate, the implied credit spread, and the implied option price. It has to be noticed that these three components also make the pricing of convertibles complex. This may add to the explanation of the observed underpricing of convertibles.

3 Data

We investigate the convertible debt issues in the Canadian market between 1998 and 2004. Data regarding the issues and their characteristics is obtained from the SDC New Issues database and from prospectuses of the issuers (available on the SEDAR web site[6]). Data on the stock prices, market indices, government bond yields, interest rates, dividends, and number of shares outstanding is obtained from Datastream. Data on convertible bond prices, their trading volumes, and number of trades is obtained from Stockwatch. Data on short interest (short sales) is obtained from the Toronto Stock Exchange Group (TSX Group). TSX provides the information on consolidated short positions for stocks traded on TSX and TSX Venture exchanges twice a month (every 15th and the last day of the month), as reported by brokers. The data on consolidated short positions provides us with a unique opportunity to examine patterns in the number of stocks sold short of the underlying equity of a convertible issue immediately after announcing and issuing the convertible. On the Canadian market short sales are said to be easier (less limitation[7]) and less costly to execute than for example in the U.S. market. This is especially the case for stocks of companies with options or convertible bonds outstanding. This makes the Canadian market a suitable setting for the investigation of short sales and convertible arbitrage returns.

3.1 Sample selection and description

As mentioned before, we have obtained the data on convertible bond issues in the Canadian market between 1998 and 2004 from the SDC New Issues dataset as the basis for our sample formation. In total, there were 88 new public convertible bond issues denominated in Canadian Dollars and registered in the SDC dataset during that period. We excluded all the exchangeable bonds[8] and zero coupon bonds. In case of exchangeable bonds the options are not written on the issuer's equity, but rather on another asset (either other companies' stocks or a specific commodity). In this case there is an additional settlement risk involved, which the valuation model does not take into account. In the case of true convertibles, the issuer can always deliver its own equity (issue new shares), so that part of the convertible value is considered to be riskless[9]. We exclude zero coupon bonds. Coupon payments are an important part of the cash flows for convertible arbitrageurs. Since zero coupon bonds do not provide these cash flows, they tend to be avoided by convertible arbitrageurs. We impose the requirement that announcement and issuance dates (completion of the offer) are verifiable either in company's announcements and prospectuses on the SEDAR website or in Lexis Nexis. These requirements reduce our sample to 72 convertibles. Finally, all our bonds in the sample should have stock price and bond price

[6]SEDAR stands for "System for Electronic Document Analysis and Retrieval" and is a service of CSA (Canadian Securities Administration) providing public securities filings. (http://www.sedar.com/)

[7]According to Universal Market Integrity Rules set by Market Regulation Services of Canada (http://www.rs.ca), which replaced rules of individual exchanges in Canada, short sales are allowed on zero tick and in certain cases also on down tick.

[8]Exchangeable bonds are bonds that are convertible into some other asset than the (equity) stock of the issuing company.

[9]The valuation approach is explained in more detail in Section 5.1.

data available on Datastream or Stockwatch, as well as all the details of the issue provided in the prospectus. This leaves us with a final sample of 61 convertible bond issues.

In Table 1 we present descriptive statistics broken down by the year of the convertible bond issue.

<Insert Table 1 here>

We observe that changes in volatility and delta closely correspond over time. In particular, the average values of delta have decreased over time, from 0.613 in 1998 to 0.111 in 2004. This implies that, according to the delta measure, the average issue was much more equity-like at the beginning of our sample period than at the end. At the same time the average volatility of the issuer's stock price also decreased from 0.485 in 1998 to 0.187 in 2004. The dividend yield increased from 3.2% in 1998 to 11.8% in 2004. The average maturity of the issue declined from 8.5 years in 1998 to around 6 years in 2003 and 2004.

The construction of the delta measure itself implies that lower volatility leads to lower delta values. The overall volatility in the market has declined after 2000, but we believe that the universe of issuers has also changed during the same period, thus additionally affecting the lower value of the delta. Given the important effect of volatility on the value of the delta, we investigate the changes in the volatility of the issuers by taking into account the changes in the market volatility at the same time. We look at the ratio between the volatility of the issuer at the time of the issue announcement and the market volatility at the same time $\left(\frac{\sigma_i}{\sigma_M}\right)$. The higher the ratio, the riskier the issuer compared to the risk of the investment in the market index. In Table 1 we observe that the ratio was the highest in 1998 (3.262), dropping over the years to 1.567 and 1.796 in 2003 and 2004 respectively. This suggests that on average the issuers became less risky.

Next, we look at the conversion premium, which is defined as the difference between the conversion price and the stock price at the issue relative to the stock price $\left(\frac{K-S}{S}\right)$. The conversion premium is inversely related to the conversion ratio. Higher conversion ratios (lower conversion premiums) indicate more equity-like convertibles (Kim, 1990) and vice-versa, since a convertible bond with a lower conversion premium is more likely to become in-the-money (all else equal) and be converted into equity. The conversion ratio (or conversion price) on which the conversion premium depends is the only parameter in Equation 2 which companies can arbitrary choose. As shown in Table 1, the average conversion premium in our sample of convertible bonds has declined from 0.297 in 1998 to 0.167 and 0.198 in 2003 and 2004 respectively. All else equal, this implies that convertible bonds have become more equity-like, which is in contrast to the conclusion based on the delta measure. However, we argue that this indicates that issuers tried to offset the effect of lower volatility by lowering the conversion premium and making the issues more attractive for the investors. Otherwise, the issues would have been even more debt-like and would probably be more difficult to sell.

Finally, we investigate the industry composition of the issuers and observe significant changes in time[10]. Financial companies (SIC division H) accounted for between 40 to 55% of issuers in

[10]We do not report complete results here. The results are available from the authors upon a request.

1998 and 1999, with almost no issuers from SIC division A (agriculture, mining and construction) during the same period. In 2001 and 2002 we observe a decrease in the number of issues by financial companies (to one-third of the issues in a given year) and an increase in the number of issuers from SIC division D (manufacturing), which accounted for about one third of the issuers. In contrast, we observe 45 to 50% of the issues in 2003 and 2004 being made by companies in agriculture, mining and construction (SIC division A).

We interpret the changes of the delta, volatility, conversion premiums and industrial composition as evidence for the fact that the universe of issuers and their characteristics has changed over time to become less risky on average. This had an important impact on the delta measure, in addition to the effect of the overall lower volatility in the market.

4 Wealth Effects Between the Announcement and the Issue of Convertible Bonds

We first investigate shareholder wealth effects related to the period between the announcement and the issuance date of convertible debt issues. Previous literature[11] on the wealth effects typically focuses on a short event window around the announcement and / or issuance dates. In contrast to that, we investigate the wealth effects between the announcement and issuance dates of convertible debt issues, as we are interested in the evolution of abnormal returns during this period, and the corresponding pattern in the short positions of the underlying stocks.

In Figure 1 we present the cumulative average abnormal returns related to the announcement and the issuance date of convertible debt issues.

<Insert Figure 1 here>

The wealth effects are presented for split sub-samples according to the delta measure, where a delta higher than 0.5 denotes more equity-like issues and a delta lower than 0.5 denotes more debt-like issues. On average, the time between the announcement and issuance date is around 15 trading days, with a median value of 14 days and with 80% of the issues being in the range between 9 and 18 trading days. Based on both plots in Figure 1 we first observe the downward pressure on the cumulative average abnormal returns (CAAR) between the announcement date (this is between days -20 and -15 relative to the issuance date) and the issuance date. Secondly and even more importantly, the negative wealth effect is more pronounced for the more equity-like convertibles. The first plot shows that the negative wealth effect of about 6%, related to the announcement of the equity-like convertible bond issues, is absorbed by the market almost instantaneously. This is in line with a previous study on the wealth effects associated with the announcements of convertible debt issues on the Canadian market (see Loncarski, ter Horst and Veld, 2006a). However, there is an additional downward pressure in CAAR of around 4% following the absorption of the announcement effect. Finally, the investigation of the second plot,

[11]For a summary of previous empirical research on announcement effects see Loncarski, ter Horst, and Veld (2006b).

where t=0 denotes the issuance date, reveals that CAAR rebound after the issue, offsetting the prior negative effect within the following month.

In Table 2 we present results of standard tests for statistical significance of CAAR, where under the null CAAR equals zero.

<Insert Table 2 here>

The wealth effects are significantly negative in the period between the announcement and the issuance date of convertibles. Equity-like convertible bond issuers experience an about 5% negative CAAR in the 15 day period leading to the issuance date versus a less than 1% negative CAAR for the debt-like convertible issuers. The difference is significant at the 5%-level for the window (-20,0), and significant at the 10%-level in the windows (-18,0) and (-15,0). It seems that most of the wealth effects, or the downward pressure on the CAAR, is concentrated in the time up to 10 trading days before the issue. Finally, the downward pressure trend of the CAAR reverses in ten to fifteen days after the issue. The more equity-like convertible issuers experience on average a significant 1.5% positive CAAR in the period of 15 to 20 days after the issue, while the effect is smaller for the more debt-like convertible bond issuers (0.6%). These results are in line with the findings of Arshanapalli et al. (2004), who investigate announcement and issuance date wealth effects for a sample of 229 convertible issues in the U.S. market in the period between 1993 and 2001. They document a significant negative CAAR of 3.8% during the period of five days leading to the convertible issue. Similarly to our findings, they also document the rebound in the returns following the issuance date. Note that they do not investigate the entire period between the announcement and the issuance date and that they do not differentiate between the more equity-like and the more debt-like convertibles.

5 Pricing of Convertible Bonds and Short Sales

5.1 Pricing of Convertible Bonds

In general, a convertible bond can be considered as a bundle of a straight bond and a warrant written on the underlying equity[12]. There are two theoretical approaches to valuing convertible debt. The so-called *structural models* use the value of the firm as the underlying state variable[13], while in the so-called *reduced form* models the value of the firm's equity or rather the default probability is modeled as underlying state variable[14]. The reduced form models have been adopted in most of the recent literature on the pricing of convertible debt.

Grimwood and Hodges (2002) argue that the most widely adopted model among practitioners for valuing convertible debt is the one first considered by Goldman Sachs in 1994 and later formalized by Tsiveriotis and Fernandes (1998). They use a binomial tree approach to model the stock price process and decompose the total value of a convertible bond (CB) in the equity

[12]Given that the exercise price is "paid" by redeeming the bonds, convertible bonds are in fact warrants with a variable exercise price.

[13]See for example Ingersoll (1977), Brennan and Schwartz (1977 and 1980), Nyborg (1996)

[14]See for example Jarrow and Turnbull (1995), Tsiveriotis and Fernandes (1998).

part and the straight debt part (so-called Cash Only part of a Convertible Bond - COCB). The holder of the hypothetical COCB receives all the cash flows, but no equity flows. The value of the COCB is determined by the convertible bond price, the underlying stock price and the time to maturity, since these so-called early exercise parameters define the boundary conditions. In other words, since early call, put or conversion is possible, the stock prices that trigger these events represent the so-called free boundaries that affect the COCB and CB values. Since the COCB is risky, the partial differential equation (Black-Scholes) must include the issuer's risk or the credit spread to account for the relevant risk. The difference between the value of the convertible bond and COCB is the payment in equity. Since the firm can always deliver its own equity, this part can be discounted using the risk-free rate[15]. In this paper we use the methodology of Tsiveriotis and Fernandes to estimate the model prices of convertible debt issues in our sample, since this approach can take into account any call, put and conversion features of convertible debt.

In order to calculate the theoretical (model) price of a convertible bond we use the following inputs. For the risk-free rate we use the yield on government bonds (Canadian) of comparable maturity as the convertible bond. A static spread is used to correct for the credit risk of the issue. Where the data on credit risk (credit rating of the issue) are not available, we assumed that the company is of the BBB risk[16]. In Datastream only Scotia Capital provides Canadian corporate bond benchmarks for different maturities and different credit ratings. They cover BBB, A and AA rankings of short, medium and long term. Based on the maturities we have extrapolated the following maturities: 1 year (equivalent to short term), 3 years (between short and medium term), 5 years (medium term), 7 years (between medium and long term), 10 years and more (long term). Based on the rankings, we have also extrapolated the rankings lower than BBB (BB and B) by adding a spread to BBB. This spread is relative to the spread between BBB and A, but is increasing in a lower credit quality and maturity. The price of the underlying stock at the valuation date is taken from Datastream, where we take the average stock price between days -12 and -2 relative to the announcement date of the issue. The number of steps in the tree is equal to the number of months to maturity at the issue of the bond. The coupon rate, the number of coupons per year, conversion ratio and call schedule are all obtained from the respective prospectuses of the bonds. With respect to the dividend information, we obtained dividend yield data from Datastream.

We define mispricing as:

$$e_{i,t} = \frac{(M_{i,t} - B_{i,t})}{B_{i,t}}, \quad (3)$$

where for every issue i e_t denotes the mispricing at time t, M_t represents the model price at time t, computed using the approach to convertible bond valuation as previously described, and B_t

[15]For more details see Tsiveriotis and Fernandes (1998).

[16]We have also computed model prices by taking the lowest possible credit quality for the issues with no credit risk information available. The mispricing was on average somewhat lower, but it did not significantly affect the results. These calculations are available upon the request from the authors.

denotes the closing market price of a convertible bond at time t.

Based on the model and observed prices we investigate the mispricing of the convertible bond issues during the first year of trading. Volatility estimates are based on a rolling window of the past 250 trading days and the delta is estimated for every individual trading day. Both, the risk-free rate and the credit spread are also considered for each trading day separately. Stock prices are matched to every individual trading day. We use constant dividend yields, computed as the average dividend yield of the past 250 trading days.

In Table 3 (Panels A and B) we present the degree of mispricing (e_t) at different points in time after the issue of the bond for the sub-samples of the equity-like and the debt-like convertibles.

<Insert Table 3 here>

First, we observe that on average the equity-like convertibles are underpriced by 25.2% (Panel A) at the issuance date, while the debt-like convertibles are on average only underpriced by 5.4% (Panel B). This difference of 19.8 percentage points is statistically significant (Panel C). The underpricing[17] at the issuance date in the overall sample is on average 10%. These results are in line with the findings of Chan and Chen (2005), who find 8% overall underpricing of convertibles at the issuance date in the U.S. market. Similarly to the higher degree of underpricing for the equity-like convertibles in our sample, Chan and Chen find riskier companies (those with low or no credit rating) to be more underpriced. In addition, Kang and Lee (1996) find a positive effect of the size of the equity component on the underpricing and King (1986) finds issuers with higher volatility of stock returns (riskier companies) to be associated with the higher underpricing[18].

Second, the underpricing on average declines in the first 15 trading days following the issue (Panel D), with a decline of 6.3 percentage points in the case of the equity-like convertibles and 2.4 percentage points in the case of the debt-like convertibles. It increases somewhat afterwards for the debt-like convertibles and remains at about 5%, while the case of equity-like convertibles shows a slight downward trend, but remains at around 19% by the end of the eleventh trading month following the issue. The difference in the underpricing between the equity-like and debt-like issues is still significant at 12.2 percentage points six months (120 trading days) after the

[17]Note, that we do not report the total sample averages in detail, but the results are available upon the request.

[18]We have also looked at the phenomenon of income trusts. Income trusts are specially designed financing vehicles, where an income trust is positioned as an immediate full owner of a typically mature business. The cash flows from the ultimate operating company, which trust owns, are usually fully distributed to the trust and then passed on to unit holders (owners of the trust) as dividends. Since the trust accrues no tax payments, investors then (depending on the tax status of their investment) either pay no or lower tax as they would otherwise. The main benefit of the income trust is therefore tax driven. Income trusts have become very popular in the Canadian market in the last few years. Jog and Wang (2004) report that the number of Income Trust IPOs grew from 9 in 1998 to 64 and 36 in 2002 and 2003 respectively, with the highest increase in the number of business trusts. Since our sample is drawn from the period between 1998 and 2004, we have looked into the impact of the income trusts on our results. 35 out of 61 of the issues in our sample have been made by income trusts. They are not uniformly distributed over time, but are rather concentrated in 2002, 2003 and 2004. This coincides with the increasing popularity of income trusts in the recent years. We have checked whether the results are driven by income trusts and found no conclusive evidence to suggest that. The strongest conclusion that can be reached is that the increase in the number of income trusts coincides with the change in the universe and characteristics of the issuers that we described in Section 3.1.

issue. This is in some contrast with the previous findings on the evolution of underpricing following the issue, since Chan and Chen (2005) show that initial underpricing dissipates within the first 500 trading days after the issue. Kang and Lee (1996) find the same to occur within the first 250 trading days following the issue.

We further investigate potential explanations for the mispricing of convertibles. We investigate explanations proposed by Lhabitant (2002) and find that the majority of the issuers, in particular those of the more equity-like convertibles, are below investment grade or without a credit rating. This reduces the liquidity of their bonds in the market. We analyze trading volumes of convertibles following the issue and find relative trading volumes[19] of the more debt-like convertibles to be significantly higher in the first 4 trading days than those of the more equity-like convertibles[20]. In Table 4 we provide correlation coefficients between trading volumes and mispricing of convertibles.

<Insert Table 4 here>

The results show that on the issuance date and the subsequent first three trading days trading volume and mispricing are significantly negatively correlated (correlation coefficients of -0.264, -0.329, -0.227 and -0.298 respectively). This suggests that part of the mispricing is to be attributed to the lower liquidity of the convertibles in early trading, in particular in the case of the more equity-like issues. This is in line with the argument of Ammann et al. (2003) that relates the underpricing to the lower liquidity of convertibles. In addition, we have seen that mispricing decreases during the first 15 to 20 trading days (see Panel D of Table 3), but nevertheless remains significantly positive afterwards. This is to a certain extent not surprising, since trading volumes and number of trades become significantly lower after the initial 5 to 10 trading days, while major investors (hedge funds) in convertible securities tend to maintain their positions for a longer period of time.

We find mispricing developments during the initial trading period particularly important for our analysis, as it shows that convertible bonds are underpriced at the issuance date. The underpricing does decrease immediately following the issue, but remains present over a longer period of time afterwards. This suggests that major activities related to convertible arbitrage take place closely around the issuance date.

So far, we have shown that the more equity-like convertibles exhibit more negative wealth effects in a period between the announcement and the issuance dates and are more underpriced. As more underpriced issues are potentially more profitable candidates for convertible arbitrage, we believe that this provides evidence that convertible arbitrage activities (shorting of the underlying stock) might further negatively affect cumulative average abnormal returns between announcement and issuance dates of convertible debt issues. If indeed the convertible arbitrage activities take place immediately after the announcement of the issue, we should be able to observe an increase in the short positions.

[19]We construct the relative trading volume as the ratio between the trading volume and the size of the convertible bond issue.

[20]Results are available from the authors upon the request.

5.2 Short Sales

One of the basic principles of convertible arbitrage is to short sell the underlying assets of the convertible bond, while purchasing the convertible bonds at the same time. An increase in the short selling activities of the underlying stock at and after the announcement of convertible bond issues, compared to levels before the announcement, can be interpreted as additional (and more direct) evidence that convertible arbitrage strategies are taking place and are affecting the cumulative average abnormal returns between the announcement and the issuance dates of convertible bond issues[21].

For the purpose of investigating the relationship between the short sales, the characteristics of the issue, the underpricing and the cumulative average abnormal returns, we define a relative measure of short sales as a ratio between the short interest in a given period[22] and the potential number of shares that are to be issued if the convertible bond issue is converted into shares[23]:

$$Z_{i,t} = \frac{ss_{i,t}}{n_i^b \cdot cr_i} \tag{4}$$

$Z_{i,t}$ represents the relative short sales (interest) measure for company i at time t (t=0 is the announcement date), $ss_{i,t}$ represents the number of shorted shares (so called short interest) of issuer i at time t, n_i^b denotes the number of issued bonds of issuer i and cr_i denotes the conversion ratio of the issue i. This measure of short interest standardizes outstanding short positions in every period with the number of new shares to be issued upon conversion of the convertible bond issue into the issuer's equity. Given the convertible arbitrage setup, we expect Z_t (cross-sectional average at time t) to be significantly higher for the more equity-like convertibles than for the debt-like convertibles following the announcement, since more shares need to be sold short given the higher delta.

In Table 5 we present the summary statistics for both the level and the changes in the relative short sales between the consecutive periods in a cross-section of issuers at given points in time t following the announcement of the issue.

<Insert Table 5 here>

With respect to the summary statistics for the measure of the level of short interest, we observe that in the case of the more equity-like issues (Panel A) the average relative short interest (Z_t) increases from around 4.5% in last period before the announcement of the issue to 25.0% of the new potentially issued shares in 4 weeks (t=2) following the announcement date. In the case of the more debt-like convertibles (Panel B) the mean relative short interest (Z_t) increases slightly from 9.3% prior to the announcement to 11.0% in the period of the announcement. It

[21] An alternative for hedging by shorting stocks is to create a hedge that involves writing call options. However, most Canadian convertibles are issued on stocks on which no exchange-traded call options are available. For this reason we limit ourselves to considering short positions in stocks.

[22] Note that the data on short interest (short positions) is available biweekly - in the middle and the beginning of every month.

[23] We have also investigated the second relative measure of short sales defined as a ratio between the short interest in a given time period and the corresponding total number of shares outstanding. The results, which are available upon the request, are very similar and downscaled only.

declines to 9.7% in 4 weeks following the announcement. The difference of 10.4 percentage points between the two sub-samples at t=1 (approximately two weeks after the announcement of the issue) is statistically significant at the 5% level (Panel C). The difference continues to increase following the announcement of the issue (t=7) to 28.8 percentage points and then declines to 17.6 percentage points after 8 months (t=16) following the issue announcement (as shown in Panel C). Even after 12 months (t=24) following the issue announcement, the mean relative short interest for the equity-like convertible issuers is 15.4 percentage points higher than the average short interest of the debt-like issuers.

Panels D and E present results for the changes in relative short interest (dZ_t) between consecutive periods. These are also based on the relative short interest measure (Z_t) and defined as differences between consecutive reporting periods ($dZ_t = Z_t - Z_{t-1}$). From these results we conclude that the highest increase in the short interest for the equity-like convertibles is at the announcement of the issue and the immediate subsequent period (average increase of 6.3 and 9.7 percentage points respectively). This is followed by a more moderate increase of 4.5 percentage points in a period between two weeks and one month (t=2) after the announcement. Afterwards, the relative short interest keeps increasing, but at a lower pace of between 2 to 3 percentage points per two weeks. Contrary to that, companies that issue debt-like convertibles experience an average 1.7 percentage points increase in short positions just after the announcement of the issue, and a 2.1 percentage points decline (complete off-set) after the issue of the bond (t=3).

Moreover, the persistence in the level of open short positions indicates that investors, who take the short position, do so over a longer period of time, which is consistent with investors that engage in convertible arbitrage rather than investors that short the stock, since they perceive it to be overvalued. If indeed this latter group of investors was shorting the stock, we would observe a decline in short positions following the abnormal returns rebound after the initial downward pressure between the announcement and the issuance dates. However, this is not the case, as can be inferred from the changes in mean values for relative short positions in Panels D and E in Table 5.

5.3 Short Sales and Wealth Effects

The relationship between short sales, structure of the convertible bond issues, and underpricing yields evidence that the more equity-like convertible bond issues are more underpriced, and thus more interesting for arbitrageurs. Since in such cases more stock has to be sold short, there should be more downward pressure on the cumulative average abnormal returns between the announcement date and the issuance date. Therefore, we examine the relationship between cumulative average abnormal returns prior to the issuance date and relative short interest by estimating the following regression model:

$$CAAR_{(t_1,t_2),i} = \beta_0 + \beta_1 \cdot Z_{i,-1} + \beta_2 \cdot dZ_{i,0} + \beta_3 \cdot dZ_{i,1} + \epsilon_i \quad (5)$$

$CAAR_{(t_1,t_2),i}$ represents cumulative average abnormal returns for the issuer i between time t_1 and t_2, $Z_{i,-1}$ represents relative short interest for the issuer i in the period before the announcement of the convertible issue and $dZ_{i,0}$ and $dZ_{i,1}$ represent the increase in short interest for the issuer i in periods 0 (around the announcement of the issue) and 1 (just before the issue of the convertible). In Table 6 we present estimates for four different event windows between the announcement and the issue of the convertible bond[24].

<Insert Table 6 here>

The longest event window that we consider is between 15 days prior to the issue and the issue of the bond. This corresponds to the time period after the announcement, in which the announcement effect has been absorbed in the stock price, and the issue of the bond (see the second plot in Figure 1). In general, we observe a significantly negative relationship between changes in relative short interest in the period of the announcement of the issue ($dZ_{i,0}$) and the cumulative average abnormal return in different time periods up to the issue of the bond. We concentrate on the period between 10 days prior to the issue and the issuance date, which corresponds to a CAAR of -0.97% for the debt-like convertibles and -1.49% for the equity-like convertibles (see Table 2). Here, we observe a significant negative effect of the pre-announcement level of the short interest (coefficient of -0.086) and a significant negative effect of the change in the short interest in the period of the announcement (coefficient of -0.174). This suggests that the average level in relative short interest in the period of the issue announcement ($dZ_{i,0}$) for the equity-like convertibles of 6.3% (see Panel D of Table 5) leads to a decline in the CAAR of 0.78% in the period between 10 days prior to the issue and the issuance date. A large part of the average CAAR during that period can be attributed to the increase in short interest ($dZ_{i,0}$). A similar result holds for the debt-like convertibles, where an average increase in relative short interest in the period of the issue announcement ($dZ_{i,0}$) of 1.7% (see Panel E of Table 5) leads to a decline in the cumulative average abnormal return of -0.30% in the period between 10 days prior to the issue and the issuance date.

We recognize the low explanatory power of the model (low adjusted R^2). It may be the case that due to the discrepancy in data between the returns and short interest (daily versus bi-weekly), we are not able to pick up the effect precisely. Ackert and Athanassakos (2005) also demonstrate a significant negative relationship between short sales and abnormal returns in the Canadian market. However, they show that this negative relationship is mitigated when companies have options or convertible bonds outstanding.

6 Convertible Arbitrage Returns

6.1 Convertible Arbitrage Setup and Returns

Until now we have presented different pieces of evidence that all indicate the existence of convertible arbitrage activities in the Canadian market. Another contribution of this paper is

[24]Note that we have trimmed the sample to 80% of the observations based on the length of the period between the announcement and the issue date (top and bottom 10% were cut). This was done in order to homogenize the length of this period (varies between 5 to 44 trading days), as we are interested in the period between the announcement date of the issue and the issuance date.

the investigation of the determinants of convertible arbitrage returns. Previous research on this topic has been done by Arshanapalli et al. (2004) and Henderson (2005).

Arshanapalli et al. (2004) investigate convertible arbitrage returns for the U.S. market in the period between 1993 and 2001. However, they use a more simplified portfolio setup. Instead of taking the delta into account, they assume equal values for the long position in convertibles and the short positions in stocks. Their results show positive convertible arbitrage returns, especially in declining equity markets. Henderson (2005) analyzes convertible arbitrage returns using data for the U.S. market in the period between 1998 and 2004. He builds his investigation of convertible arbitrage returns by taking into account the time-varying delta value of convertibles when establishing the hedge ratio. However, he does not take into account the conversion ratio of the convertibles and the short interest rebate[25]. He does include the borrowing costs for the investment in convertibles.

We employ a simple convertible arbitrage strategy, where we go long in one convertible bond at the issuance date and short the appropriate number of underlying stock (corresponding to the conversion ratio). In this way we achieve a delta neutral hedge at the issuance date. We rebalance the short position as the delta changes over time and we consider the so-called short interest rebate. We take borrowing costs into account, as proceeds from shorted stock do not suffice for the purchase of a convertible bond. For every convertible issue i, we form the following convertible arbitrage portfolio at time t:

$$
\begin{aligned}
P_{i,t} = \quad & \underbrace{(B_{i,t} + I_{i,t})}_{\text{Convertible bond part}} \quad - \\
& \underbrace{(\Delta_{i,t} \cdot cr_i \cdot (S_{i,t} + D_{i,t}) - (\Delta_{i,t} - \Delta_{i,t-1}) \cdot cr_i \cdot S_{i,t})}_{\text{Stock part}} + \\
& \underbrace{(\Delta_{i,t} \cdot cr_i \cdot S_{i,t-1} \cdot g_i \cdot w_{i,t})}_{\text{Short position rebate}} - \\
& \underbrace{((B_{i,0} - \Delta_{i,0} \cdot cr_i \cdot (1 - g_i) \cdot S_{i,0}) \cdot l_{i,t})}_{\text{Borrowing part}},
\end{aligned} \tag{6}
$$

where for every issue i $P_{i,t}$ denotes the value of the convertible arbitrage portfolio at time t, $B_{i,t}$ denotes the convertible bond price at time t, $I_{i,t}$ denotes the accrued interest at time t, $\Delta_{i,t}$ denotes the delta value of the convertible bond issue at time 0 (issuance date), cr_i denotes the conversion ratio, g_i denotes the short interest coverage ratio, w_i denotes the short interest rebate rate per period t, $S_{i,t}$ denotes the stock price at time t, $D_{i,t}$ denotes the dividend at time t and $l_{i,t}$ denotes the borrowing cost from t=0 up to time t.

The convertible bond part is made of the bond price at time t and the accrued interest or coupon payment at time t. The stock part refers to the short position in the issuer's stock, where we assume to take a short position (hedge ratio) in $\Delta_{i,t} \cdot cr_i$ shares. This means that we

[25] This is interest paid on the share of proceeds of sale of shorted stock that needs to be kept with the broker as a coverage (margin) for future delivery of shorted stock

hedge the quantity of shares equal to the conversion ratio (shares that we would receive in the case of conversion of the convertible) taking into account the sensitivity of the convertible price to the changes in the stock price (delta). The short interest rebate refers to the interest paid on the margin requirement with the broker for the future delivery of shorted stock. Here, we assume the margin requirement (g_i) to be 50% and the short interest rebate rate ($w_{i,t}$) to be 75% of the short-term interest rate. Finally, the borrowing part refers to the borrowing cost that the arbitrageur incurs by borrowing the shortfall of funds needed to establish a long position in convertibles at the issuance date. More specifically, the arbitrageur shorts $\Delta_{i,0} \cdot cr_i$ shares, but she needs to maintain a margin requirement (g_i). She therefore needs to borrow the difference $B_{i,0} - \Delta_{i,0} \cdot cr_i \cdot (1 - g_i) \cdot S_{i,0}$ at interest rate $l_{i,t}$. Here, we assume that the borrowing rate equals the short-term interest rate.

We compute returns on convertible arbitrage portfolios as:

$$R_{i,t} = \ln P_{i,t} - \ln P_{i,t-1} \tag{7}$$

Finally, we average the daily convertible arbitrage portfolio returns in a cross-section at each time t and sum them up to obtain cumulative returns for the different time periods. In Table 7 we present the cumulative average returns (buy-and-hold strategy at the issue) of convertible arbitrage, convertible bonds and stocks (raw returns) for the sub-samples of the more equity-like ($\Delta_i > 0.5$) and the more debt-like ($\Delta_i < 0.5$) convertibles.

<Insert Table 7 here>

From Table 7 we observe that the returns on convertible arbitrage are positive over different time periods immediately following the issue of the bond, both for the equity- and the debt-like convertibles. In the case of the equity-like convertibles, convertible arbitrage (Convertible Arbitrage column of Panel A) earns a return (R_t) of around 33.8% in one year, while for the debt-like convertibles this is 10.7% (Convertible Arbitrage column of Panel B). This result is driven by the very negative return on the underlying stock of around 34.4% (Stock column of Panel A) for the equity-like convertibles (at t=240). This, coupled with the higher delta, generates the positive return difference for convertible arbitrage for the equity-like convertibles.

The returns on the long position in convertible bonds, although positive for the first six months (120 trading days) after the issue, turn negative to -8.5% (Convertible Bond column of Panel A) by the end of the first year after the issue compared to the issuance date price. For the debt-like convertibles, which have low deltas, the average convertible arbitrage return of around 10.7% is by 5.1 percentage points lower than 15.8% return (Convertible Bond column of Panel B) on the convertible bond by the end of the first year of trading. The difference is due to the positive return on the underlying stock, which, given the short positions, offsets the gain on the long position in the bond. Contrary to the equity-like convertibles, the returns on the convertible bonds are positive for the more debt-like convertibles after the first year of trading.

More interesting is the question of the determinants of convertible arbitrage returns and the evolution of the returns in the first year of trading. By the construction of the convertible arbitrage it is clear that convertible arbitrage returns will be driven by returns on the long position in convertibles and returns on short position in stock - i.e. the strategy will make positive returns when either bond prices rise or stock prices fall, all else equal. Given that other parameters in the setup do not change (conversion ratio, margin requirement) or change very little (short interest rebate rate, borrowing rate), we focus on convertible bond returns and raw stock returns.

First, we observe that within 20 trading days following the issue, the returns on the more equity-like convertibles significantly outperform returns on the more debt-like convertible by 3.4 percentage points (Convertible Bonds column of Panel C). At a similar time (15 trading days following the issue), convertible arbitrage returns on the more equity-like convertibles are also significantly higher than those on the more debt-like convertibles. The difference in stock returns between the more debt-like and the equity-like convertible bond issuers is not significant during the same period. This indicates that during this initial period following the issue, convertible arbitrage returns are mostly driven by convertible bond returns. These in turn are mostly driven by increases in stock prices (positive returns for both equity-like and debt-like convertibles). Note that convertible bond prices positively co-move with the stock prices. Both, downward and upward movements in stock prices, have a dual effect on convertible arbitrage returns, directly via the stock part of the convertible arbitrage return and indirectly via the convertible bond part of the return. The indirect effect depends on the delta, as a higher delta corresponds to the higher sensitivity of the price of a convertible bond to the changes in the price of the underlying equity.

In Figure 2 we present the evolution of the returns on the convertible strategy, convertible bonds and stocks for the sub-samples of the more equity and the more debt-like convertibles during a period of one year following the issue of the bond. We have argued that dissipation of underpricing, driven by increases in convertible bond prices in the initial trading, affects the positive returns on convertible arbitrage in the period immediately following the issuance of the bonds.

<Insert Figure 2 here>

In Figure 2 we observe that in the later period, in particular beyond the first 120 days of trading, the negative stock returns dominate the convertible arbitrage returns for the more equity-like convertibles. In case of the more debt-like convertibles, the positive stock returns depress the convertible arbitrage returns in comparison to the convertible bond returns. It seems that convertible arbitrage strategies earn very high returns in the case of adverse selection of the issuers and/or the down equity markets. This is in line with the findings of Arshanapalli et al. (2004).

6.2 Performance of Convertible Arbitrage Hedge Funds

The performance of hedge funds that are involved in convertible arbitrage strategies has been decreasing over time. In Table 8 we present the returns on Convertible Arbitrage Index HEDG

CA that is tracked by CFSB/Tremont, convertible arbitrage returns based on our sample and MSCI World and S&P 500 indices.

<Insert Table 8 here>

Based on the returns presented in Table 8 we observe that, apart from two setbacks in 1994 and 1998, returns on the HEDG Convertible Arbitrage index have for the most part been above 15%. However, the convertible arbitrage performance has deteriorated in later years. The popular press provides different explanations for this, ranging from stable equity markets, rising interest rates, withdrawals from funds, to increased competition in the hedge fund industry and lower volatilities in the main capital markets. Given the set-up of the convertible arbitrage strategy, these factors indeed contribute to a decreased performance. However, we believe (as we showed in Section 3.1) that the structure of the convertible bond (convertible being either debt- or equity-like) is an important additional explanatory factor to be considered.

An important part of the return in the convertible arbitrage strategy represents the profit from the underpricing of convertible bond issues. Here, we argue that convertible arbitrage performance may critically depend on the degree of mispricing of convertible bond issues, which has shown to be to a large extent determined by characteristics of any particular issue. In other words, the more equity-like convertible bonds are likely to be more underpriced than debt-like convertible bonds, as we have shown in previous sections. As the structure of the convertible bond changed over time from the more equity-like to more debt-like, we observe less underpricing and less true arbitrage opportunities for convertible arbitrage strategies. Moreover, we have shown that the returns on the more equity-like convertibles were also driven by the negative stock returns. This is in line with the returns in Table 8, where the highest returns were recorded in downward pressured or stagnating stock markets and years, in which most of the issues were more equity-like (end of the nineties, beginning of two thousand). It also shows that our sample is representative of the overall convertible arbitrage hedge fund universe or, put differently, that Canada is in that respect not different from the other markets in which convertibles are mostly traded and hedge funds are engaged in convertible arbitrage activities.

In Table 9 we provide the mean for the delta and the mispricing values averaged across the years of convertible debt issues for the sub-samples of the more equity and the more debt-like convertible bond issues.

<Insert Table 9 here>

We observe from the table that the mispricing of the convertible bond issues declines over time. This corresponds to the change in the structure of convertible bond issues from the predominantly equity-like issues in late 1990s to the more debt-like issues in 2003 and 2004 (as measured by delta). This is in line with the discussion regarding the change in the universe of issuers in Section 3.1. Second, we demonstrated (see Table 7) that the convertible arbitrage returns are lower for the debt-like convertibles compared to the equity-like convertible bond issues. Finally, this change towards more debt-like issues corresponds in time to the decline in convertible arbitrage returns in Table 8. We interpret joint evidence on the higher underpricing and higher convertible arbitrage returns for the equity-like issues, coupled with the shift towards more debt-like issues in recent years, as an additional explanation for the corresponding deteriorating performance of convertible arbitrage hedge funds. Moreover, the results for both the equity-like and the debt-like sub-samples suggest that underpricing seems to be time invariant and is crucially driven by the structure of the issue[26].

7 Conclusion

This paper studies convertible bond arbitrage on the Canadian market. This activity mostly takes place by hedge funds, which do not report their holdings. For this reason we have to rely on a series of indirect evidence to see whether convertible arbitrage is really taking place. We find several pieces of evidence for convertible arbitrage. First, we find a downward pressure on cumulative average abnormal returns between the announcement and the issuance date of the bond for more equity-like convertible bonds. Second, we find that the convertible bonds are underpriced. Both effects are stronger for the equity-like than for the debt-like convertible bonds. Finally, we find that short positions in the underlying stocks strongly increase around the issuance date. This effect only takes place for the equity-like convertible bonds. We also show the negative relationship between the short interest and cumulative average abnormal returns. When looking at the returns of convertible bond arbitrage strategies, we find that the equity-like convertible bonds have earned much higher returns than the debt-like convertible bonds. This difference is approximately 23 percentage points during the first year following the issue. Returns on the convertible arbitrage strategy strongly decrease towards the end of the sample period. This is mostly caused by the fact that convertible bond issuers tend to make their issues more debt-like compared to the early years in our sample. This is, of course, not surprising. The high returns of the hedge funds have come at the expense of the companies issuing convertible bonds. In order to cap their losses, they have apparently switched to issuing less underpriced debt-like convertible bonds.

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Table 1

Descriptive statistics (number of observations, mean and standard deviation) for maturity (in years), delta, issuer and market volatilities, conversion premium, and dividend yield. The statistics are provided based on the year of the issue. T represents the maturity of the bond at the issue. Both, issuer and market volatility (σ_i and σ_M) are the annualized standard deviations of daily stock returns and returns on S&P TSX composite index based on 250 trading days prior to the announcement of the convertible bond issue. The delta measure (Δ_i) is computed as defined in Equation 2. The conversion premium (cp_i) is defined as $\frac{K-S}{S}$, where K represents the conversion price and S represents the stock price at the announcement date of the issue. The dividend yield (δ_i) is the average dividend yield over the 250 trading days prior to the announcement of the issue.

year		T	Δ_i	σ_i	σ_M	$\frac{\sigma_i}{\sigma_M}$	cp_i	δ_i
1998	N	9	7	9	9	9	8	7
	Mean	8.49	0.613	0.485	0.144	3.262	0.297	0.032
	std. dev.	2.24	0.287	0.417	0.017	2.626	0.159	0.052
1999	N	5	4	5	5	5	4	4
	Mean	4.61	0.405	0.441	0.196	2.264	0.174	0.099
	std. dev.	1.67	0.271	0.179	0.004	0.956	0.163	0.076
2001	N	7	7	7	7	7	7	7
	Mean	5.68	0.613	0.548	0.211	2.685	0.077	0.035
	std. dev.	0.93	0.330	0.367	0.025	1.826	0.100	0.052
2002	N	12	12	12	12	12	12	12
	Mean	5.14	0.368	0.389	0.167	2.310	0.233	0.085
	std. dev.	0.17	0.286	0.225	0.017	1.284	0.300	0.072
2003	N	11	11	11	11	11	11	11
	Mean	6.26	0.239	0.228	0.143	1.567	0.165	0.090
	std. dev.	1.78	0.267	0.142	0.021	0.854	0.174	0.055
2004	N	17	17	17	17	17	17	17
	Mean	6.73	0.111	0.187	0.104	1.796	0.198	0.118
	std. dev.	1.94	0.093	0.038	0.008	0.383	0.394	0.041

Table 2

Wealth effects associated with the issuance dates of convertible bond issues for the split subsamples based on the delta measure. The cumulative average abnormal return (CAAR) window is relative to the issuance date (issuance date = 0). The difference in means is computed as a one-sided test where, under the null hypothesis, CAAR for the more debt-like convertibles ($\Delta_i < 0.5$) are less or equal to CAAR for the more equity-like convertibles ($\Delta_i > 0.5$).

***, ** and * denote significance at the level below 1, 5 and 10% respectively. Under the null means are equal to zero.

CAAR window		$\Delta_i < 0.5$		$\Delta_i > 0.5$		**diff. in means**	
-20	0	***	-0.58%	***	-6.11%	**	-5.52%
-18	0	***	-0.49%	***	-4.82%	*	-4.33%
-15	0	***	-0.89%	***	-4.62%	*	-3.74%
-10	0	***	-0.97%	**	-1.49%		-0.52%
-5	0	***	-0.37%	*	-1.25%		-0.88%
-2	0		-0.08%		-0.70%		-0.62%
0	1	***	-0.60%		-0.42%		0.18%
0	3		-0.11%		0.09%		0.20%
0	5		0.10%		-0.93%		-1.03%
0	10		0.27%		0.00%		-0.26%
0	15	***	0.59%	**	1.24%		0.65%
0	20		0.17%	**	1.57%		1.40%

Table 3

Descriptive statistics (mean, minimum and maximum value, median and standard deviation) for the mispricing measure $e_{i,t}$, which represents a comparison of the model price to the trading price at time t. ID+t denotes t days after the issuance date of the convertible bond.

***, ** and * denote significance at the level below 1, 5 and 10% respectively. Under the null means are equal to zero.

Panel A: Mispricing after the bond issue for the sub-sample of the more equity-like convertibles

period	N	mean		min	max	median	sd
ID	12	0.252	***	0.021	0.500	0.262	0.154
ID+5	12	0.226	***	-0.008	0.471	0.251	0.161
ID+10	12	0.203	***	-0.020	0.463	0.234	0.147
ID+15	12	0.197	***	-0.038	0.473	0.213	0.150
ID+20	13	0.208	***	-0.017	0.472	0.210	0.165
ID+30	13	0.194	***	-0.026	0.514	0.211	0.154
ID+60	14	0.201	***	-0.019	0.499	0.182	0.156
ID+120	15	0.179	***	-0.069	0.402	0.185	0.137
ID+220	15	0.189	***	-0.117	0.848	0.108	0.237

Panel B: Mispricing after the bond issue for the sub-sample of the more debt-like convertibles

period	N	mean		min	max	median	sd
ID	40	0.054	***	-0.067	0.223	0.046	0.066
ID+5	42	0.043	***	-0.078	0.174	0.038	0.061
ID+10	42	0.036	***	-0.115	0.184	0.030	0.059
ID+15	42	0.026	***	-0.121	0.180	0.023	0.060
ID+20	42	0.031	***	-0.105	0.179	0.037	0.060
ID+30	44	0.036	***	-0.090	0.204	0.031	0.063
ID+60	44	0.044	***	-0.067	0.193	0.040	0.058
ID+120	44	0.057	***	-0.091	0.380	0.044	0.093
ID+220	44	0.053	***	-0.127	0.516	0.032	0.119

Table 3 continued

Panel C: Difference in means between the two sub-samples based on the delta measure

period	diff. in means	95% conf. int.		t	
ID	-0.198	-0.298	-0.099	-4.328	***
ID+5	-0.183	-0.286	-0.080	-3.867	***
ID+10	-0.167	-0.262	-0.073	-3.848	***
ID+15	-0.171	-0.267	-0.074	-3.856	***
ID+20	-0.177	-0.278	-0.076	-3.794	***
ID+30	-0.158	-0.252	-0.064	-3.613	***
ID+60	-0.157	-0.248	-0.066	-3.688	***
ID+120	-0.122	-0.201	-0.042	-3.206	***
ID+220	-0.136	-0.271	-0.001	-2.124	**

Panel D: Difference in means between different time periods after the issue for the sub-samples of the more equity and debt-like convertibles

periods	$\Delta_i > 0.5$ pairwise diff.		$\Delta_i < 0.5$ pairwise diff.	
ID to ID+5	-0.026	***	-0.009	**
ID to ID+10	-0.049	***	-0.016	***
ID to ID+15	-0.055	***	-0.026	***
ID to ID+20	-0.063	***	-0.024	***
ID+20 to ID+60	0.008		0.009	*
ID+60 to ID+120	-0.038	**	0.013	
ID+120 to ID+220	0.010		-0.004	

Table 4

Correlations between mispricing and trading volume. e_t denotes the average mispricing at time t (average in a cross-section) based on a comparison of the model price at time t ($M_{i,t}$) to the trading price ($B_{i,t}$) at time t=0 (issuance date) for each issue i. t in the first column denotes day after the issue (i.e. t=5 denotes the fifth trading days after the issue). The first number in each field is a coefficient of correlation and the second number is a p-value (under the null hypothesis that there is no correlation).

volume	e_0	e_1	e_2	e_3	e_4	e_5	e_{10}	e_{20}
t=0	**-0.264**	**-0.257**	**-0.242**	**-0.234**	-0.227	-0.189	-0.195	**-0.247**
	0.061	**0.066**	**0.085**	**0.092**	0.102	0.177	0.161	**0.072**
t=1	**-0.377**	**-0.329**	**-0.323**	**-0.323**	**-0.300**	**-0.293**	**-0.275**	**-0.312**
	0.006	**0.017**	**0.020**	**0.018**	**0.029**	**0.033**	**0.046**	**0.022**
t=2	**-0.283**	**-0.234**	-0.227	**-0.235**	-0.224	-0.219	-0.202	**-0.239**
	0.044	**0.095**	0.106	**0.090**	0.108	0.115	0.147	**0.081**
t=3	**-0.352**	**-0.319**	**-0.320**	**-0.298**	**-0.285**	**-0.265**	**-0.313**	**-0.367**
	0.011	**0.021**	**0.021**	**0.030**	**0.038**	**0.056**	**0.023**	**0.006**
t=4	-0.161	-0.139	-0.123	-0.110	-0.094	-0.099	-0.070	-0.164
	0.260	0.326	0.385	0.434	0.505	0.479	0.620	0.236
t=5	-0.172	-0.133	-0.121	-0.116	-0.117	-0.097	-0.124	**-0.238**
	0.227	0.347	0.393	0.407	0.406	0.488	0.378	**0.083**
t=10	-0.057	-0.009	0.006	0.009	-0.005	0.027	0.029	-0.166
	0.689	0.949	0.964	0.951	0.974	0.851	0.835	0.231
t=20	0.079	0.075	0.112	0.120	0.134	0.118	0.064	0.053
	0.583	0.598	0.428	0.393	0.338	0.399	0.649	0.704

Table 5

Descriptive statistics (mean, minimum, maximum, median and standard deviation) for the relative measure of short interest for the sub-samples of equity and debt-like convertibles. The relative short interest is defined as $Z_{i,t} = \frac{ss_i}{n_i^b \cdot cr_i}$, where $Z_{i,t}$ represents the relative short sales (interest) measure for company i at time t (t=0 is the short interest reporting period at the announcement date of the issue), $ss_{i,t}$ represents number of shorted shares of issuer i at time t, and cr_i denotes the conversion ratio of the issue i. Δ_i denotes the delta value of the issue.

***, ** and * denote significance at the level below 1, 5 and 10% respectively. Under the null means are equal to zero.

Panel A: Relative short interest for the sub-sample of the more equity-like issues ($Z_{\Delta_i > 0.5, t}$)

period	**N**	**mean**	**min**	**max**	**median**	**sd**
t=-2	17	0.037	0.000	0.270	0.013	0.066
t=-1	17	0.045	0.000	0.269	0.013	0.074
t=0	17	0.107	0.000	0.368	0.061	0.117
t=1	17	0.205	0.000	0.664	0.135	0.211
t=2	17	0.250	0.001	0.780	0.158	0.252
t=3	17	0.272	0.000	0.800	0.218	0.258
t=4	17	0.306	0.000	0.952	0.194	0.309
t=5	17	0.333	0.000	1.128	0.249	0.335
t=6	17	0.345	0.000	1.119	0.236	0.342
t=7	17	0.375	0.000	1.320	0.240	0.394
t=8	17	0.354	0.000	0.971	0.246	0.343
t=16	17	0.316	0.007	0.788	0.254	0.269
t=24	17	0.285	0.010	0.813	0.210	0.250

Table 5 continued

Panel B: Relative short interest for the sub-sample of the more debt-like issues ($Z_{\Delta_i<0.5,t}$)

period	N	mean	min	max	median	sd
t=-2	40	0.086	0.000	0.770	0.011	0.172
t=-1	40	0.093	0.000	0.598	0.016	0.160
t=0	40	0.110	0.000	0.587	0.023	0.165
t=1	40	0.100	0.000	0.633	0.021	0.163
t=2	40	0.097	0.000	0.602	0.026	0.160
t=3	40	0.076	0.000	0.578	0.031	0.132
t=4	40	0.091	0.000	0.640	0.039	0.154
t=5	40	0.092	0.000	0.545	0.042	0.137
t=6	40	0.094	0.000	0.551	0.043	0.142
t=7	40	0.087	0.000	0.557	0.051	0.124
t=8	40	0.087	0.000	0.546	0.055	0.123
t=16	40	0.140	0.001	0.999	0.077	0.192
t=24	40	0.131	0.000	0.478	0.057	0.147

Panel C: Difference in means between the sub-samples; under the alternative hypothesis $Z_{\Delta_i>0.5,t} > Z_{\Delta_i<0.5,t}$

Period	diff. in means	95% conf. int.		t	
t=-2	0.049	-0.014	0.113	1.563	
t=-1	0.049	-0.014	0.111	1.565	
t=0	0.002	-0.075	0.080	0.060	
t=1	-0.104	-0.222	0.014	-1.818	**
t=2	-0.153	-0.290	-0.016	-2.307	**
t=3	-0.196	-0.334	-0.058	-2.966	***
t=4	-0.215	-0.379	-0.050	-2.725	***
t=5	-0.241	-0.417	-0.065	-2.874	***
t=6	-0.251	-0.431	-0.072	-2.929	***
t=7	-0.288	-0.493	-0.082	-2.950	***
t=8	-0.267	-0.446	-0.087	-3.123	***
t=16	-0.176	-0.324	-0.028	-2.446	**
t=24	-0.154	-0.289	-0.020	-2.380	**

Table 5 continued

Panel D: Between periods changes in the relative short interest for the sub-sample of the more equity-like issues ($dZ_{\Delta_i>0.5,t} = Z_{\Delta_i>0.5,t} - Z_{\Delta_i>0.5,t-1}$)

period	N	mean	min	max	median	sd
t=-1	17	0.008	-0.015	0.109	0.000	0.029
t=0	17	0.063	-0.002	0.228	0.054	0.069
t=1	17	0.097	0.000	0.328	0.070	0.103
t=2	17	0.045	-0.008	0.153	0.020	0.053
t=3	17	0.022	-0.027	0.105	0.007	0.036
t=4	17	0.034	-0.105	0.457	0.001	0.122
t=5	17	0.027	-0.016	0.175	0.005	0.049
t=6	17	0.012	-0.064	0.066	0.008	0.031
t=7	17	0.030	-0.166	0.647	0.000	0.166
t=8	17	-0.021	-0.393	0.038	0.000	0.097

Panel E: between periods changes in the relative short interest for the sub-sample of the more debt-like issues ($dZ_{\Delta_i<0.5,t} = Z_{\Delta_i<0.5,t} - Z_{\Delta_i<0.5,t-1}$)

period	N	mean	min	max	median	sd
t=-1	40	0.007	-0.358	0.306	0.001	0.079
t=0	40	0.017	-0.186	0.251	0.001	0.071
t=1	40	-0.009	-0.379	0.320	0.000	0.091
t=2	40	-0.003	-0.560	0.330	0.000	0.117
t=3	40	-0.021	-0.486	0.040	0.000	0.087
t=4	40	0.015	-0.041	0.348	0.000	0.059
t=5	40	0.001	-0.537	0.342	0.000	0.105
t=6	40	0.002	-0.074	0.114	0.000	0.032
t=7	40	-0.007	-0.418	0.127	0.000	0.077
t=8	40	0.000	-0.123	0.053	0.000	0.030

Table 6

Estimation results for the OLS regression model (see equation 5). The dependent variable is the cumulative average abnormal return (CAAR) between time t_1 and t_2 for different values of t_1 and t_2, where t=0 represents the issuance date of the convertible bond issue. $Z_{i,-1}$ represents the relative short interest (as defined in equation 4) for the issuer i in the short interest reporting period before the announcement of the convertible issue, and $dZ_{i,0}$ and $dZ_{i,1}$ represent the change in the short interest for the issuer i in periods 0 (around the announcement of the issue) and 1 (around the issue of the convertible) compared to the previous period. Standard errors in the regressions are White heteroskedasticity corrected.

***, ** and * denote significance at the level below 1, 5 and 10% respectively.

variable	**coeff.**	**s.e.**	**t-value**	**p-value**		**adj.** R^2
			t_1=-15, t_2=0			
$Z_{i,-1}$	-0.038	0.055	-0.690	0.495		
$dZ_{i,0}$	-0.325	0.146	-2.220	0.032	**	
$dZ_{i,1}$	-0.086	0.078	-1.100	0.277		
constant	-0.023	0.014	-1.560	0.126		0.033
			t_1=-10, t_2=0			
$Z_{i,-1}$	-0.086	0.037	-2.300	0.027	**	
$dZ_{i,0}$	-0.174	0.085	-2.050	0.047	**	
$dZ_{i,1}$	-0.038	0.044	-0.860	0.394		
constant	0.000	0.009	0.030	0.979		0.039
			t_1=-5, t_2=0			
$Z_{i,-1}$	-0.051	0.027	-1.900	0.064	*	
$dZ_{i,0}$	-0.156	0.064	-2.430	0.020	**	
$dZ_{i,1}$	-0.045	0.038	-1.210	0.233		
constant	-0.003	0.008	-0.380	0.703		0.024
			Issue date			
$Z_{i,-1}$	-0.008	0.012	-0.660	0.515		
$dZ_{i,0}$	-0.036	0.047	-0.770	0.445		
$dZ_{i,1}$	-0.029	0.018	-1.560	0.127		
constant	0.001	0.003	0.180	0.855		-0.033

Table 7

Cumulative average daily returns of convertible arbitrage (R_t), convertible bonds and stocks for the sub-samples of the more equity ($\Delta_i > 0.5$) and the more debt-like ($\Delta_i < 0.5$) convertibles at the different periods following the issue. The reference date for the accumulation of the returns is the issuance date of the bond (t=0).

***, ** and * denote significance at the level below 1, 5 and 10 percent respectively. Under the null means are equal to zero.

Panel A: Returns for the sub-sample of the more equity-like issues ($\Delta_i > 0.5$)

		Convertible Arbitrage			**Convertible Bond**			**Stock**		
period	N	**mean**	**median**	**sd**	**mean**	**median**	**sd**	**mean**	**median**	**sd**
t=1	12	0.039 **	0.010	0.073	0.008 **	0.005	0.013	-0.006	0.000	0.013
t=5	12	0.033 **	0.024	0.053	0.017 ***	0.013	0.020	0.007	0.008	0.033
t=10	12	0.052 **	0.038	0.083	0.036 ***	0.029	0.032	0.021	0.009	0.062
t=15	12	0.075 ***	0.072	0.070	0.048 ***	0.048	0.045	0.046 *	0.042	0.094
t=20	12	0.062 *	0.071	0.148	0.063 ***	0.058	0.061	0.058 **	0.081	0.110
t=40	12	0.177 ***	0.164	0.129	0.070 ***	0.067	0.086	0.015	0.062	0.183
t=60	12	0.125 **	0.092	0.162	0.043	0.048	0.139	-0.008	0.042	0.282
t=120	12	0.214 **	0.134	0.299	0.022	0.048	0.142	-0.132 *	-0.157	0.261
t=240	12	0.338 ***	0.214	0.358	-0.085	0.049	0.333	-0.344 **	-0.253	0.656

Table 7 continued

Panel B: Returns for the sub-sample of the more debt-like issues ($\Delta_i < 0.5$)

		Convertible Arbitrage			Convertible Bond			Stock		
period	N	**mean**	**median**	**sd**	**mean**	**median**	**sd**	**mean**	**median**	**sd**
t=1	40	0.006 ***	0.004	0.012	0.005 ***	0.002	0.010	-0.002	0.000	0.013
t=5	40	0.013 ***	0.013	0.019	0.011 ***	0.013	0.012	0.004	0.006	0.040
t=10	40	0.016 ***	0.016	0.018	0.019 ***	0.021	0.016	0.016 ***	0.009	0.035
t=15	40	0.023 ***	0.023	0.019	0.027 ***	0.027	0.019	0.018 ***	0.019	0.046
t=20	40	0.023 ***	0.024	0.021	0.029 ***	0.031	0.023	0.020 **	0.019	0.055
t=40	40	0.035 ***	0.031	0.038	0.045 ***	0.044	0.044	0.041 ***	0.044	0.093
t=60	40	0.037 ***	0.042	0.065	0.050 ***	0.057	0.065	0.053 ***	0.054	0.096
t=120	40	0.060 ***	0.057	0.082	0.090 ***	0.081	0.083	0.071 ***	0.085	0.149
t=240	40	0.107 ***	0.083	0.125	0.158 ***	0.130	0.148	0.092 **	0.105	0.251

Panel C: Difference in means under the alternative hypothesis: $R_{\Delta_i > 0.5} > R_{\Delta_i < 0.5}$

	Convertible Arbitrage		Convertible Bond		Stock	
period	**diff. in means**	**t**	**diff. in means**	**t**	**diff. in means**	**t**
t=1	-0.033	-1.542 *	-0.003	-0.791	0.004	0.837
t=5	-0.021	-1.335	-0.006	-1.073	-0.003	-0.246
t=10	-0.036	-1.486 *	-0.016	-1.665 *	-0.006	-0.293
t=15	-0.052	-2.581 **	-0.022	-1.601 *	-0.028	-1.018
t=20	-0.038	-1.209	-0.034	-1.901 **	-0.038	-1.155
t=40	-0.142	-3.773 ***	-0.025	-0.983	0.026	0.472
t=60	-0.087	-1.826 **	0.007	0.180	0.061	0.737
t=120	-0.153	-1.756 *	0.068	1.575 *	0.204	2.582 **
t=240	-0.231	-2.194 **	0.243	2.453 **	0.436	2.255 **

Table 8

Returns on Convertible arbitrage performance index (HEDG CA), convertible arbitrage in the sample (CA sample), MSCI World Stock Index and S&P 500 index. Data is provided by CFSB/Tremont HedgeIndex (http://www.hedgeindex.com). Note that year in the convertible arbitrage returns of the sample refers to the year of the convertible bond issue.

Year	HEDG CA	CA sample	MSCI World Index	S&P 500
2005	-3.48%		7.61%	4.88%
2004	1.98%	15.97%	15.25%	10.88%
2003	12.90%	11.02%	33.76%	28.68%
2002	4.05%	16.64%	-19.54%	-22.10%
2001	14.58%	27.81%	-16.52%	-11.89%
2000	25.64%		-12.92%	-9.10%
1999	16.04%	55.23%	25.34%	21.04%
1998	-4.41%	-3.83%	24.80%	28.58%
1997	14.48%		16.23%	33.36%
1996	17.87%		14.00%	22.96%
1995	16.57%		21.32%	37.58%
1994	-8.07%		5.58%	1.32%

Table 9

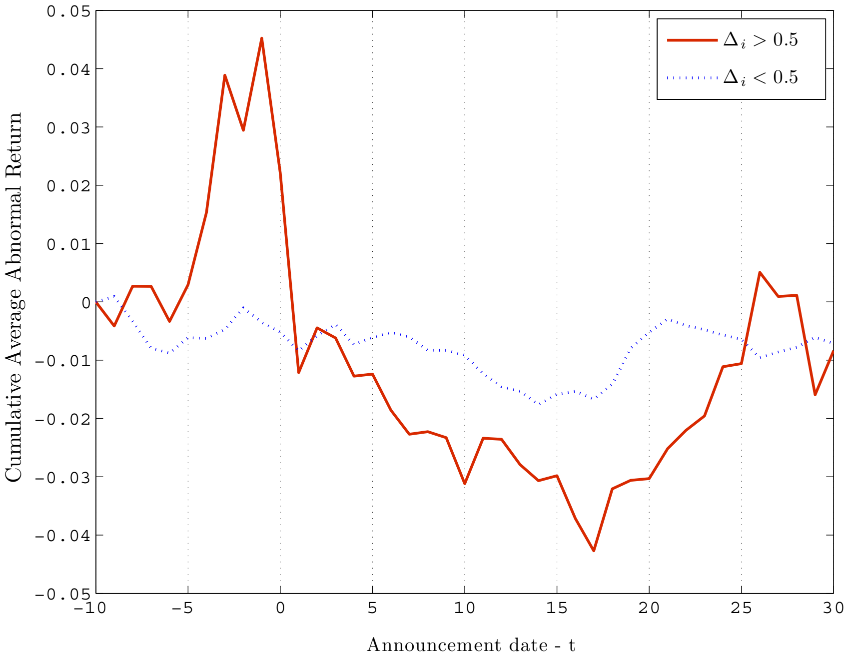
Mean values of delta (Δ_0) and the mispricing (e_0) at the issuance date of the convertible bond across the years of the issue.

Year	Δ_0	e_0
1998	0.453	0.072
1999	0.363	0.181
2001	0.524	0.276
2002	0.243	0.129
2003	0.148	0.061
2004	0.068	0.047

Figure 1

Wealth effects associated with the announcement and the issuance dates of convertible debt issues for the sub-samples of more debt-like ($\Delta_i < 0.5$) and more equity-like ($\Delta_i > 0.5$) convertibles.

Reference point: announcement date



Reference point: issue date

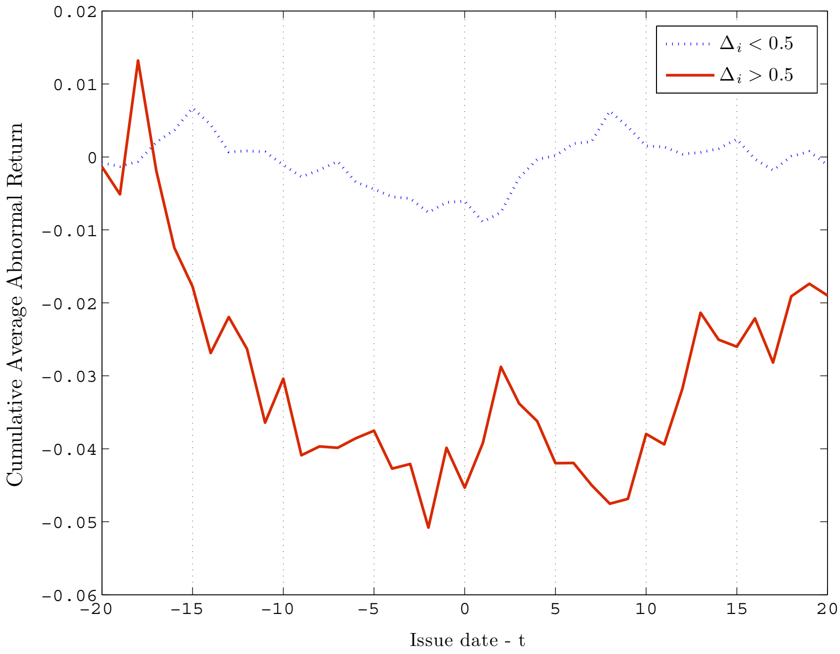


Figure 2

Cumulative average convertible bond returns, raw stock price returns and convertible arbitrage returns for convertible arbitrage portfolio as defined in equation (6) for the sub-samples of equity-like and debt-like convertibles.

Equity-like convertibles ($\Delta_i > 0.5$)

Debt-like convertibles ($\Delta_i < 0.5$)