WHERE CONVERTIBLES FIT WITHIN THE INVESTMENT LANDSCAPE

by

DANIEL RABER

A THESIS

Presented to the Department of Business
and the Robert D. Clark Honors College
in partial fulfillment of the requirements for the degree of
Bachelor of Science

May 2024

An Abstract of the Thesis of

Daniel Raber for the degree of Bachelor of Science
in the Department of Business to be taken June 2024

Title: Where Convertibles Fit Within the Investment Landscape

Approved: *Brandon Julio Ph.D.*
Primary Thesis Advisor

This paper examines both the qualitative and quantitative side of convertible debt. The clash between equity holders and debt holders can cause friction due to differing incentives and convertible debt is a tool to prevent this friction. While equity holders may have a higher risk tolerance due to a return profile, that incentivizes taking on risky projects, debt holders may not invest enough in projects that can grow a company. This qualitative aspect explains how convertible debt can reduce this agency conflict.

Moving forward, this paper examines convertible debt from an investors standpoint to determine whether it should be included in an optimal portfolio. Through this, portfolio optimization is viewed through the Sharpe Ratio, Treynor's Ratio, and the Markowitz Model. Through the research and data analysis process it is determined that convertible debt fits more with institutional investors rather than retail investors. Furthermore, hybrid securities such as convertible debt can be advantageous for start-ups that may have a difficult time raising capital otherwise.

Acknowledgement

I would like to especially thank my primary thesis advisor, Professor Brandon Julio, for the guidance during the thesis writing process. His expertise in financial valuation played a pivotal role during each of the stages of my thesis project. Whether it was where to start regarding the literature in the space, or a new way to approach my data analysis, meeting with Professor Brandon Julio enhanced the quality of my work and made the process more rewarding. Additionally, while gaining insight into constructing a thesis at a bachelor's level, meeting with Professor Brandon Julio provided valuable insight regarding how research is performed at a graduate level. I found it highly interesting to learn more about how research within the financial industry is performed in academia.

Table of Contents

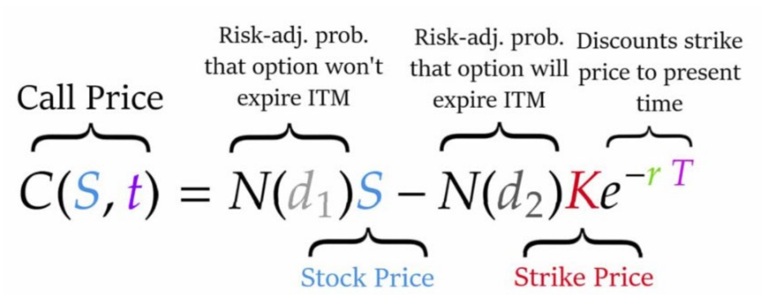
Literature Review

What is a convertible?

One key aspect of running a company is raising capital. There are multiple methods companies can use to raise capital. Companies can approach this task from an equity, debt, or even a hybrid security approach. For the equity approach a company will issue additional stock, which causes dilution to current shareholders. These shareholders often comprise of employees, founders, and investors. The capital structure of a company is divided into debt and equity. When additional shares are added the pie stays the same size but now the pie has more slices. This is dilution; the shareholders now own a smaller percentage of the company. Additionally, companies can raise capital through issuing debt. Raising debt enables a firm to avoid dilution, but now the firm must make payments on the debt. Additionally, raising debt is easier said than done when it comes to new companies, and companies with copious amounts of debt. Sometimes issuing equity is the only viable option. Another aspect to acknowledge is: who gets paid first in a bankruptcy event? Debt holders get paid before equity holders. On the upside, debt holders are typically capped on their returns (percentage that is agreed upon) and equity holders can in theory have their shares approach infinity.

With debt and equity fundraising options there is a "hybrid" option that utilizes aspects of both fundraising pathways. An example of this is a convertible bond; convertible bonds enable an investor to invest in a debt security that can later be converted to equity. Given the shares hit a certain price by a certain date, the bond holder would be able to convert into equity. If an investor expects a stock price to increase and wants to limit downside, a convertible bond represents an ideal method to do so.

The key nuance to convertible bonds arises from the callable feature that issuers typically place on their convertible bond issuances. In Korkeamaki and Moore's study of convertible debt, 13 out of the 705 convertible bonds in the sample didn't have a call provision. This represents under 2 percent and exemplifies how most convertible bond issuances have a call feature. This feature means that once the stock price crosses a current price threshold the issuer of the convertible bond can essentially force the conversion to happen within 30 to 60 days (Mikkelson, 1981). By moving up the expiration of the conversion component, typically referred to as a warrant, the warrant component is worth less. This is captured within the Black-Scholes formula, where *t* is the time to maturity. When *t* is smaller the warrant component is worth less.



The warrant component that I am referring to is synonymous with a call option when it comes to the Black-Scholes pricing formula. For context, a warrant is when the security is issued by the underlying firm and an option is issued on the secondary market by an investor that is not the firm. A warrant is dilutive because it means that additional shares will be created if it is exercised, a call option does not. In this case an investor that collects the payment from the call option would pledge their shares in case it is exercised.

The term ITM stands for in-the-money which refers to whether the warrant/call option will be profitable to exercise. This would mean that the strike price is below the current market price of the stock. Risk adjusted means that the pricing model takes into account the volatility of the option/warrant and calculates returns given inherent volatility. Otherwise, it would be comparing apples to oranges to compare the potential return of a warrant to a risk-free security, such as a treasury bill. The risk adjusted return means that one can compare the return of the option to a risk-free security adequately. When it comes to this equation, *t* refers time; based on the Black-Scholes formula options that have less time to expiration, or *t*, are worth less than options with more time to maturity. With the callable feature inherent to most convertible options, the forced conversion mechanism can make it that the time to expiration decreases and that the warrant can decrease in value.

Management Perspective – Why Convertible Debt?

Much of the literature published within the convertible debt space typically makes an argument for or against convertible debt. The literature encompasses the stakeholders that are impacted by convertible debt transactions, such as management members, equity holders, and debt holders. Additionally, the dynamics of why a company would choose to issue convertible debt are explored and these firms are characterized.

Firstly, it is critical to pinpoint the intentions of a company issuing convertible debt. Stein claims that convertible bonds act as "backdoor equity financing" to incorporate equity within a firm's capital structure. As discussed earlier, most bonds have a callable feature; this forced conversion means that companies can get equity into their capital structure. Beyond this, some firms have limited financing options. New firms may lack an adequate credit score which leads to high interest debt (Lyandres, Zhdanov, 2015).

Credit Spreads

For larger firms (market cap > $5 billion)			
If interest coverage ratio is			
>	*≤ to*	*Rating is*	*Spread is*
-100000	0.199999	D2/D	20.00%
0.2	0.649999	C2/C	17.00%
0.65	0.799999	Ca2/CC	11.78%
0.8	1.249999	Caa/CCC	8.51%
1.25	1.499999	B3/B-	5.24%
1.5	1.749999	B2/B	3.61%
1.75	1.999999	B1/B+	3.14%
2	2.2499999	Ba2/BB	2.21%
2.25	2.49999	Ba1/BB+	1.74%
2.5	2.999999	Baa2/BBB	1.47%
3	4.249999	A3/A-	1.21%
4.25	5.499999	A2/A	1.07%
5.5	6.499999	A1/A+	0.92%
6.5	8.499999	Aa2/AA	0.70%
8.50	100000	Aaa/AAA	0.59%

Source: Damodaran

As you can see, the lower the credit score the lower the interest coverage ratio and the higher the credit spread. With the lower interest rate coverage this implies that companies that have lower credit scores are worse off to pay their debt. Additionally, they will have to pay a higher interest rate. The spread refers to the additional percentage above the risk-free rate. Companies with lower credit scores are worse off to cover their debt payments and also have to pay more in interest.

With a low credit score leading to a higher interest rate on debt, companies may be swayed to issue convertible debt to effectively issue debt at a lower interest rate. The lower interest rate is achieved through the warrant component, which has value, and thus leads the debt portion to be offered at a lower interest rate. One rebuttal to this claim that Mayers makes is that newer firms may view their current stock price as undervalued and want to take non-dilutive financing pathways. Mayers also notes that roughly 2/3 of managers believe that their convertible debt would convert. Asquith's data is in line with this and concludes that roughly 2/3 of convertible bonds are converted. This data leads one to acknowledge that the issuance of convertible debt typically leads to future equity dilution. The redeeming attribute is that when equity is diluted the stock price will be higher. This makes the issuance of convertible debt more attractive than equity but less attractive than straight debt. However, this is only under the assumption that the stock price will rise, and the warrant component of the convertible debt will be exercised.

While selling undervalued equity is nonsensical for a company, it is also important to acknowledge that selling equity for an overvalued company is completely sensical. In the scenario where the equity is undervalued it makes more sense for a company to issue debt, however, as I discussed some companies may have limited financing options. This interpretation helps explain the results by Spiess and Afleck-Graves. Spiess and Affleck-Graves concluded that 58.9% of companies that issue convertible debt underperform competitors. This contrasts with debt offerings which have a 54.5% rate. Both data points were found to be statistically significant despite being close to 50% which would indicate no difference between these companies and their peers that didn't raise debt or convertible debt. Underperformance refers solely to stock price performance.

Returns Post Convertible Debt or Straight Debt

Spiess and Affleck-Graves further their explanation into how equity prices are impacted by convertible debt and straight debt issuances. While stock price underperformance may not always be immediately recognized, the impact on a stock price can be more long-term. On the equity issuance front, Ritter and Loughran find that the negative impact of an initial public offering (IPO) can last for up to five years. An IPO refers to the first time that a company sells its stock to the public. Stein states that an equity issuance has a negative equity impact of roughly 28% while a convertible debt issuance has a negative impact of roughly 9%.

Spiess and Afleck-Graves continue to make the argument that convertible debt has a return profile similar to a United States Treasury. Treasuries are regarded as a risk-free security with a guaranteed return. This contrasts with equities that have returns that are variable; debt issued by companies that could default, which could lead to debtholders not receiving the initial agreed return percentage, and thus have default risk not making it a risk-free asset. With the risk inherent risk of equity and debt the authors assess that a 4% risk premium is warranted. When incorporating this premium in addition to the risk-free rate the authors conclude that the return of convertible debt is comparable to a risk-free United States Treasury.

One proposed explanation for the disappointing returns attributable to convertible debt is mean reversion. Management will likely take advantage of a stock price run up to issue equity or even convertible debt, which can more likely than not be dilutive (Spiess, Affleck-Graves, 1996). When examining this explanation, it makes logical sense, as a company that recently had a large increase in stock price will probably have the price normalize and no longer continue rising rapidly. Evidence for this explanation exists when Spiess and Affleck-Graves conclude that convertible debt issuances have a correlation to previous stock price run-ups that is not shared with a typical debt offering.

Asymmetric Information

While convertible debt can be used as a tool to be less dilutive than a common equity issuance and less burdensome than straight debt, there are also other tools that could theoretically accomplish the same outcome. Davidson, Glascock, and Schwartz state that a firm could issue short term debt and, when it becomes due, issue equity to use these funds to cover the outstanding debt. This could be less dilutive than a convertible issuance because instead of having an exercise price that is below the market value of the equity, the company will be able to sell equity that at market value. The one area where this argument fails to cover is the conflicting incentives of equity holders and debt holders.

Lyandres and Zhdanov explain how the incentives of equity holders are starkly different in comparison to debt holders. Debt holders will have more of an emphasis on projects with stable cash flow that can repay the debt. On the contrary, equity holders will have more of an emphasis on high growth opportunities that are riskier for debtholders. Lyandres and Zhdanov also state how equity holders may be willing to invest in projects that have a negative net present value (NPV).

Net present value or NPV takes into account the costs of a project today and the potential payoff in the future. The payoff in the future is discounted to be equivalent to dollars today, because a dollar today is worth more than a dollar tomorrow. The future payoff is compared to the current cost, and this determines the net present value. If the net present value is negative this means that the cost is greater than the payoff. On the contrary, if the net present value is positive this means that the payoff is greater than the cost.

While debt holders want companies to invest in positive NPV projects to pay off debt, equity holders may not align with this. The authors state that equity holders are more willing to invest in projects that would increase human capital (employees) despite such a project having a negative NPV. The authors also note how this overinvestment incentive of equity holders is also prevalent in buyouts where management teams, that often have equity compensation, often overstate acquisition synergies. Basic math constitutes that one plus one equals two, but a synergy would be a situation where one plus one equals three. The entities, or businesses, are worth more together than separate.

While the previous authors note how equity holders are led to overinvest, Parino and Weisbach discuss how debt leads to underinvestment through risk aversion. This leads to an agency conflict among equity and debt holders, which isn't quite novel but adds another layer of complexity to the typical conflict between management and other business stakeholders.

Stein makes the argument that convertible debt bypasses much of the agency conflict between equity and debtholders through his "risk-shifting" hypothesis. The hypothesis explains that the different alignment of incentives arises from impact of the consequences. For example, an equity holder is more willing to invest in the negative NPV project that could lead to long-term growth while having the immediate impact of not being able to fulfil debt payments. Eliminating one side of the conflict also isn't a viable solution. It isn't wise to have a company that takes on unnecessarily risky projects in an effort to grow or a company that refuses to use viable growth opportunities to its benefit. Neither side can be isolated to solve the problem and when the two sides are competing against each other there is clear conflict. This is where Stein makes the argument that convertible debt causes a "risk-shifting" behavior that leads a company to more optimal investment. Otherwise, a company can face value destruction where the firm can decrease in value.

In the conversation of agency conflict the term growth is used quite generously, and this term shouldn't be glossed over. Smith and Watts confirm that growth opportunity and leverage are inversely correlated. Meaning, firms that have many growth opportunities lack the financial means to do so and vice versa. This reiterates the classification of companies that take on convertible debt. Companies don't just take on convertible debt for convenience but take such a measure out of necessity. Larger more established companies have easy access to capital but are no longer in a growth stage. Small to medium-sized businesses have less of a track record but are in a growth stage. The inverted correlation of growth opportunity to financial leverage is a testament to how convertible debt doesn't just decrease agency conflict but fosters growth.

Sequential Financing Exploration

Up until now capital structure seems to be static, through issuances of securities that seem to be one-time transactions. However, capital structure is more dynamic, and this must be taken into consideration. Mayers describes how raising capital isn't a singular occurrence and that firms will need to consider their financing over the long term. While the argument as to why convertible debt is more efficient, in comparison to other financing meanings, for a one-time transaction, it is critical to also recognize the sequential nature. In other words: how does issuing convertible debt for a current transaction impact the costs related to future financing transactions? These costs surpass literal costs such as the interest rate, but also apply to agency costs and the impact on firm value when there is friction between stakeholders. Mayers' study analyzes the different financing methods, including equity, debt, and convertible debt and tries to find which method does the best job minimizing cost while being able to capture the most value from projects that have a positive NPV. It is noted in the study that such an offering was able to capture value from projects with growth opportunity but not go too far and lead to overinvestment. Convertible debt was proven to be able to capture value from multiple positive NPV growth and opportunities. Mayer demonstrates that convertible debt isn't just efficient for the short-term but also efficient for a longer-term outlook that includes sequential financing.

JetBlue Case Study

JetBlue is an airline based out of the east coast and has a history of issuing convertible debt. Most recently, the company issued $740 million worth of convertible debt that will be due in 2026 (Fitch, 2023). JetBlue has a history of issuing convertible debt when the company has been struggling, whether it be relative to competitors, or a poor macroeconomic environment such as that in 2008. As of the most recent offering, the company had underperformed relative to competitors when it came to profitability, and credit rating agencies such as Fitch were skeptical regarding a potential acquisition of Spirit. JetBlue affirmed that the company would de-lever following the acquisition; to hypothetically acquire Spirit Airlines the company would likely increase its leverage, or debt to equity ratio, which is seen as a risk. Furthermore, while the company was able to improve margins, the company also was facing a pilot union contract which represented a risk to margins. At the time of this convertible debt offering the company was already highly levered. The company had $3.5 billion in fixed interest debt. To put this in perspective, during the same quarter the company had roughly $2 billion in current assets. Current assets refer to a thing of value that the company is expecting to sell within a year. This demonstrates how already the company had a lot of debt and was facing potential issues on many fronts. A secured debt offering could have been the answer, but the company already had a credit facility that was backed by its airline spots at its airports that it lands at. With such headwinds a convertible debt offering makes the most sense. The company was at a point where it needs to invest in positive NPV projects, but not misallocate its capital as it is a finite resource. Rather than focusing on a lower percent debt payment, convertible debt represented the best way for the company to move forward.

Markowitz Model

The invention of the Markowitz Model was instrumental for the world of finance, leading to the Capital Asset Pricing Model (CAPM) and resulted in being awarded the noble prize in 1990 (Elbannan, 2014). Markowitz created the foundation regarding risk return payoff, one tenet of this foundation includes the presence of risk aversion among investors. This plays a key role in calculating an optimal portfolio and also estimating the price of assets. The Markowitz model also set the stage for the Fama and French model. The Fama and French model is a multi-factor model, where Markowitz is a single-factor model, yet the Fama and French model uses the CAPM as one of its factors. Essentially, the Fama and French model utilizes more inputs and is a more complex model. Given the limited data set, which will be discussed in the results section, the Markowitz model is more practical for the data set in this paper.

$$E[R] = Rf + B * ERP$$

The CAPM is an integral component of modern-day stock valuation and communicates the expected return for an equity. It takes several inputs including beta, risk-free rate, and equity risk premium that will be described in greater depth in the rest of the methods section. CAPM calculates the cost of equity, or the return that an equity investor would need to get as a return given the systematic risk of the investment.

Within the CAPM there are multiple elements including beta, the risk-free rate, and equity risk premium. Beta refers to systematic risk, or how sensitive a security is to events that impact the entirety of the market. Risk-free rate refers to the return that one can expect without taking on virtually any risk. Equity risk premium refers to the additional return that investors require for taking on additional systematic risk, which is represented by beta. Within the methods section, I will expand on how these terms and how my data will calculate them.

Mutual Fund Dynamics

A mutual fund is a vehicle where investors can purchase units in a diversified portfolio that is managed by a professional management company. These funds have fund goals and are highly liquid as the fund can purchase shares back from investors based on the net asset value. Within the context of my research, I utilized convertible debt mutual funds to determine whether they belong in an optimal portfolio.

When mutual funds are purchased, a customer pays a sales fee which is called a front load fee. Beyond this there are other fees relating to management that are paid for the mutual funds and even the Wilshire 5000 that I used as an index. Furthermore, these fees are typically paid annually, not at purchase, and are deducted from the net asset value of (NAV) such funds.

$$Net\ Asset\ Value = \frac{Assets - Liabilities}{Shares}$$

As you can see there are three levers to decrease net asset value. Firstly, you decrease the amount of assets. This could be a 12b-1 marketing/advertising fee that is assessed annually and paid by shareholders and decrease assets through deducting the fee from the mutual funds assets. Secondly, an increase in liabilities will decrease net asset value. Thirdly, an increase in the share count will decrease net asset value. More shares may be issued in an effort to raise funds while being dilutive to shareholders. When mutual funds are bought or sold, they are sold on a per unit basis based on the NAV. This is why I only manually calculated the sales fee, which is called the front-load fee, because the other costs are encapsulated in the NAV which is reflected in the mutual fund price.

Methods

In order to retrieve data on convertible debt, I utilized convertible debt funds that actively purchase convertible debt issuances. This enabled me to track cumulative returns across the past 28 years in the convertible debt market. To choose convertible debt funds I chose funds that have daily trading data going back to 1995 with a current market capitalization of over $1 billion. Additionally, these funds have a majority concentration of their holdings in the United States; this was critical to acknowledge when deciding which benchmark to incorporate within my analysis. By being at a larger market capitalization these funds also tend to purchase debt across multiple sectors; this reduces the chance of convertible debt issuances in a particular industry obscuring the results that I gathered.

Convertible Debt Funds

1. The Mainstay Funds (MCOAX)
2. Franklin Investors Securities (FISCX)
3. Fidelity Financial Trust (FACVX)

Benchmark Thought Process

When analyzing the returns of the convertible debt funds I needed a benchmark to compare the funds against. The convertible debt funds encapsulated debt issuances mostly across the United States stock market, with a minority allocation to international debt issuances. With this in mind, I analyzed different benchmarks typically used within portfolio return analysis. In doing so, I came across the Russell 3000, S&P 500, and Wilshire 5000. Ultimately, I chose to use the Wilshire 5000 as a benchmark. The Wilshire 5000 was founded in 1974 and captures the entirety of publicly traded US Stocks (Hayes, 2022). The Russell 3000 captures 98% of publicly traded US stocks. The S&P 500 only encapsulates approximately 80% of US public markets. Based on a need to accurately measure the entire performance of the US stock market, it made the most sense to use the Wilshire 5000.

Percentage Returns

When analyzing the returns on the convertible debt funds, percentage returns were one of the key metrics that I analyzed. Going back to 1995, I calculated annual returns and took an average to attain the average annual return expected with each investment. The front-load fee attributable to the convertible debt mutual funds provided a layer of nuance. A front-load fee is an initial sales charge that is deducted from the principal of an investment. For the funds used in this thesis, the front-load fees fell within the range of 5 to 6 percent. The funds had additional management fees, but these were already captured in the adjusted close figures, meaning that no additional calculations were required to encapsulate them. To analyze the funds, I measured the percent returns on an annual basis accounting for the front-load fee, as well as without the front-load fee incurred at the theoretical purchase at the beginning of the year. The primary goal of the project was to compare the performance of convertible debt to equities, which made the front-load fee important to acknowledge but not the only direction to take the project.

Alpha (α)

$\alpha = Rp - Rf$

Rp: Portfolio return

Rm: Market return

Alpha refers to the return incurred over the benchmark, in this case being the Wilshire 5000. I calculated both alpha with and without the front-load fee. In the investing world it is desirable to maximize alpha, while also taking other factors into account. An alpha of 0 means that the performance is in line with the Wilshire 5000. A positive number would imply outperformance relative to the Wilshire 5000, while a negative alpha value would imply an underperformance relative to the Wilshire 5000.

Beta (*B*)

While maximizing alpha is ideal, metrics such as beta must be acknowledged. Beta serves as a proxy for volatility, more specifically how sensitive the asset is to factors that impact the market as a whole, also referred to as systematic risk. The general market index has a beta of 1. A security with a beta of 1.05 would rise by 5% when the market would increase by 1%; the inverse would be true when the general market decreases by 1%, the security would decrease by 5%. Due to debt being less volatile than equities, straight debt and convertible debt funds tend to trade at a beta of less than 1.

Risk-free Rate

The risk-free rate refers to the percent return that an investor can achieve without taking on risk. For this, the 10-year United States Treasury is the accepted standard. For this project I approximated an average based on the past nearly 30 years.

Sharpe Ratio

The Sharpe ratio is used to determine the optimal portfolio allocation towards individual assets or funds. Rather than solely focusing on what funds will achieve a maximum return percentage, the Sharpe ratio also considers volatility. This also, is the case for Treynor's ratio and Jensen's alpha ratio.

$$Sharpe\ Ratio = \frac{(Rp - Rf)}{\sigma}$$

Rp: Expected Return of Portfolio

Rf: Risk-free rate

SD (σ): Standard Deviation

In the numerator the formula is calculating the excess return that a fund or security returns. This is in excess of the risk-free rate which would be the return that one can generate without taking on any risk. In application, this would be the United States government 10-year Treasury Bill. The denominator is the standard deviation of the fund or security; this is a proxy for volatility.

In practice, the Sharpe ratio is typically used. The metric is quite simple to compute as it is a single index model, which means it takes a single market index. To add complexity the Markowitz model is used, but this will be expanded upon later in this paper. To calculate the optimal holdings within a portfolio diversification is used as an adjustable parameter. In my study, I used Microsoft Excel to output the maximum Sharpe ratio that a portfolio of equity and convertible funds. The program indicated the optimal weightings of the different funds in the hypothetical portfolio.

While easier to implement, the Sharpe Ratio does have areas of concern for my research. Mainly, the Sharpe ratio doesn’t account for correlations between funds within a portfolio. The Markowitz model would be more apt to overcome this concern. Additionally, the assumption works under the model that risk means volatility and all volatility is treated the same. The other models look at volatility differently. When it comes to risk there is systematic and firm specific risk. Systematic risk would impact the entire market, while firm specific would be particular to a firm or industry. For example, an increase in interest rates would be systematic as it would generally impact the entire market. When it comes to firm specific risk this could be a lawsuit that could result in a company having to pay a large fine.

Another area where the Sharpe Ratio falls short is option pricing. The Sharpe Ratio isn't designed to work with a distribution that is skewed to the extent of options. While my data isn't looking at option pricing, the convertible debt mutual funds hold convertible debt that has a warrant component. As discussed in my literature review, the warrant component is priced the same way as an option with the Black-Scholes formula.

Treynor Ratio

The Treynor ratio has a similar formula yet different representation than the Sharpe Ratio. Firstly, the diversification mechanism that can alter the Sharpe Ratio isn't present in the Treynor Ratio (Virma, Jayshil, et al, 2016). This means that under Treynor's Ratio, risk can't be eliminated by increasing diversification. When it comes to the risk that is encapsulated by the ratio it only takes into consideration systematic risk. This means that identical portfolios with the same systematic risk, but different firm specific risks will be ranked the same.

Systematic Risk + Firm Specific Risk = Total Risk

$$Treynor\ Ratio = \frac{(Rp - Rf)}{B}$$

Rp: Expected Return of Portfolio

Rf: Risk-free rate

B: Beta

As you can see, the Treynor Ratio is nearly identical to the Sharpe Ratio. The difference between the two ratios is the denominator, where Treynor uses beta instead of standard deviation. As stated previously, beta serves as a proxy for systematic risk.

Jensen's Alpha

Jensen's Alpha formula deviates from the formula format of Sharpe and Treynor. Instead, Jensen's Alpha is derived from the Capital Asset Pricing Model (CAPM). The Capital Asset Pricing Model is used in equity valuation to calculate the cost of equity.

$\text{CAPM} = Rf + B * (Rp - Rf)$

Rp: Expected Return of portfolio

Rf: Risk-free rate

B: Beta

The CAPM formula provides one with the minimum return needed for an equity investor. With equity there is inherent risk, and the equity holder must be compensated for this risk. Jensen Alpha calculates the excess return needed above the CAPM.

$\text{Jensen's } \sigma = \text{Rp} - \text{Rf} + \text{B} * (\text{Rm} - \text{Rf})$

Rp: Expected Return of portfolio

Rf: Risk-free rate

B: Beta

Similar to the alpha metric, Jensen's alpha is a popular metric within the world of finance. Dissimilar to the standard alpha metric, Jensen's iteration is risk adjusted. The risk adjusted theme is also prevalent among the Sharpe and Treynor ratio. Another area of overlap is with the Treynor ratio; this is regarding the beta. The use of B or Beta in Jensen's formula also encapsulates the systematic risk. In other words, this is the risk a firm, fund, or asset class can't avoid. In my data analysis I utilize Jensen's alpha in addition to the traditional alpha metric to provide a wider scope of data analysis.

Markowitz Model Nuance

The Markowitz model adds more to the Sharpe Ratio. Primarily, the model encapsulates covariance, and the Sharpe Ratio does not.

COVARIANCE = (correlation between two variables) x (σ of first variable) x (σ of second variable)

When it comes to my data analysis, I am anticipating covariance. This is because debt holders and equity holders both have a claim to firm value. This means when firm value changes both debt and equity holders will be impacted. As stated earlier, debt has precedence over equity when it comes to repayment, meaning that debt will not be impacted quite as much as equity. However, both should share this covariance. The Markowitz model is also better suited of handling more complex scenarios where there are many portfolios to choose to hypothetically invest in. Despite the less complex nature of asset allocation that I have constructed, due to fewer portfolios to invest in, I opted to utilize the Markowitz model.

Data Retrieval and Cleaning

To collect data I used Yahoo Finance to compile the stock returns for the benchmark and convertible debt funds that I analyzed. Furthermore, I cleaned the data using Excel. For the funds I have annual returns going back from 1995 to 2023. I calculated the annual returns to compute the average return and operated under the assumption that the average returns are the expected returns moving forward. Otherwise, to calculate metrics I would have to make multiple assumptions to speculate and form an expected return for each of the funds.

For beta I operated under the assumption that the Wilshire 5000 was the market index and has a beta of 1. To calculate the beta of the convertible debt funds I regressed the returns of convertible debt mutual funds to the Wilshire 5000. In my beta tab there are multiple beta metrics that are calculated, including daily and weekly metrics. With the convertible debt mutual funds typically trading with lower volume, there are null daily values which makes it that it wasn't possible to populate accurate daily values. Given this, I ended up choosing the 5-year weekly beta to encapsulate a large sample size that still accounts for trading volatility.

As mentioned earlier, the convertible debt mutual funds have front load fees which are charged at the time of purchase for the convertible funds. Also, I incorporated analysis both with and without the fees included. The main reason behind this is that the aim of this study is to analyze where convertible fits within the investment ecosystem; this surpasses retail investors that will mainly reach such exposure through these funds. This study is also applicable to institutional investors, such as asset managers that can invest in convertible directly rather than indirectly through the publicly traded funds that I incorporated into my study.

Analysis Methods

To further my Sharpe Ratio analysis, I used Jensen's Alpha to incorporate the impact of systematic risk through the use of this risk-adjusted metric. Furthermore, I incorporated Treynor's ratio and Markowitz's model to increase more nuance to my optimal portfolio analysis, despite the Sharpe ratio having a foothold within academia and the portfolio management space. Throughout my analysis I used Microsoft Excel to categorize my data across multiple tabs that could reference each other. By using Excel it was easy to update my data analysis and incorporate additional metrics and analysis as I came across additional areas of inquiry through my ongoing research process.

Results

Sharpe Analysis – Front and No Front

As a recap, I analyzed my data in two iterations. I included the convertible debt mutual funds with returns that incorporated the front load fee and without the front load fee. For an explanation on why I chose these two iterations reference the methods section.

When the front load fees are assessed to the convertible debt mutual funds they underperform the index, or the Wilshire 5000. This makes it, to no surprise, that they are not included in the optimal portfolio when it comes to Sharpe Ratio, Treynor Ratio, or Markowitz model. When the index on average returns about 10 percent it is difficult for the convertible debt mutual funds to achieve positive alpha when 5 percent is deducted from the principal at the beginning of the year. Yearly returns were computed based on the beginning of year price with the front load deducted and the adjusted close for the year end price. Since 1995 these returns were averaged to get an average return for the convertible debt mutual funds and the Wilshire 5000. I assumed that the average return for the last nearly 30 years could be reasonably accepted moving forward and used this percentage to forecast the expected return for each of the funds. Beta was also computed based on this logic and the past nearly 30 years were averaged for each of the convertible debt mutual funds. With these assumptions under the Sharpe Ratio, Treynor Ratio, and Markowitz Model the results were that the convertible debt mutual funds did not have a place within the optimal portfolio. However, the results were different when assessing the front load fee only at the beginning of time series and converting this return to an annual basis.

Up until this point front load fees were assessed on an annual basis to compute annual returns and these returns were averaged to get an expected return for the convertible debt mutual funds. However, as I will explore more in my conclusion section, assuming a 1 year holding period may be unrealistic. When assessing the front load fee at the beginning of the time series, then calculating the return up until year end of 2023, I computed a 28-year return. Furthermore, I converted the 28-year to an annual basis to get an annual return. With this slightly nuanced approach the Markowitz Model indicates that it is optimal to include at least one convertible debt mutual fund in the optimal portfolio. The Sharpe and Treynor ratio did not indicate this. While it was optimal to include more than just the index fund in the optimal portfolio, the index still made up the majority of the portfolio. For the Markowitz model the index made up 69%.

Sharpe Allocation Table

	Alpha	Beta (*B*)	SD	Weights
FISCX	-.01	.67	.169	0
PACIX	-.014	.62	.175	0
MCOAX	-.019	.63	.157	0
W5000	0	1	.164	0

Expected Return E[R]	.098
SD	.232
Sharpe Ratio	.230

The Sharpe Ratio recommended not including the convertible debt mutual funds in the optimal portfolio. With negative alphas, which indicates underperformance relative to the index, they were not included. Despite betas being lower than one, indicate less systematic risk, this was not enough to include within the Sharpe Ratio optimal portfolio. While they underperformed relative to the index, they also contained less systematic risk than the index. The underperformance wasn't as large as when the front load was assessed on an annual basis, so the tradeoff for a slightly lower return relative to the index for a fund with lower volatility made it not worthwhile as it made the funds not weighted in the Sharpe Ratio portfolio. While, under this front load iteration, the Sharpe ratio included no convertible debt mutual funds and the Markowitz model only included FISCX.

Markowitz Model Allocation Table

	Returns	Weights
FISCX	.089	.312
PACIX	.084	0
MCOAX	.079	0
W5000	.098	.69

Expected Return E[R]	.095
SD	.164
Sharpe Ratio	.31

Under this front load iteration, the FISCX convertible debt mutual fund outperforms relative to the other convertible debt mutual funds. Additionally, one area that the Sharpe and Treynor Ratio lack exposure to is covariance.

Covariance Matrix

	W5000	FISCX	PACIX	MCOAX
W5000	.032	.022	.023	.02

FISCX	.022	.026	.023	.021
PACIX	.022	.023	.023	.02
MCOAX	.02	.021	.02	.02

Covariance indicates whether the funds move in tandem or are correlated. This is somewhat similar to the idea of beta, but rather than just comparing each fund to the index the funds are also compared to each other. As apparent with the covariance matrix, there is not too much correlation across the funds as they are close to 0. However, they are all positively correlated to a degree, and this isn't encapsulated in the other measures used in this paper. The Sharpe Ratio analysis has more of an emphasis on diversification to maximize the ratio. The Markowitz Model takes note of the little covariance and thus doesn't rely as heavily on diversification to make the portfolio more optimal.

No Front Load Fee

When there is no front load fee assessed the Sharpe Ratio and the Markowitz Model both recommend investment in the index and convertible debt funds. The Treynor Ratio recommends only investing in the market index. As with the front load iteration the Sharpe Ratio recommends investing primarily in the index with the remainder of the portfolio being invested in convertible debt. It recommends only invest in convertible debt funds FISCX and PACIX while choosing not to invest in MCOAX. The interesting part of this is the MCOAX trades at a noticeably lower beta than the two other funds.

Sharpe Allocation Table

	Alpha	Beta (*B*)	SD	Weights
FISCX	.008	.67	.169	.24
PACIX	.005	.62	.175	.208
MCOAX	-.004	.63	.157	0
W5000	0	1	.164	.550

Expected Return E[R]	.09
SD	.19
Sharpe Ratio	.24

When looking at the Markowitz model for the no front load iteration the results are vastly different than the front load iteration as well as the other models that were constructed.

Markowitz Model Portfolio Allocation

	Returns	Weights
FISCX	.106	.368
PACIX	.104	.607
MCOAX	.094	0
W5000	.098	.025

Expected Return E[R]	.104
SD	.162
Sharpe Ratio	.37

Unlike the other models described in this section, the Markowitz model with no front load suggests that it would be optimal to primarily invest in the convertible debt mutual funds rather than the index. Most notably, this model encapsulates covariance within its calculation.

Covariance Table

	W5000	FISCX	PACIX	MCOAX
W5000	.032	.022	.023	.021
FISCX	.023	.029	.026	.023
PACIX	.024	.026	.026	.022
MCOAX	.021	.024	.022	.022

When comparing this to the front load fee, the Markowitz Model has a covariance that is virtually identical. The main differentiator of this iteration of data is that the expected returns of two mutual funds outpace the index. This, paired with a beta lower than one implies lower systematic risk, leading to a larger portfolio concentration within the convertible debt mutual funds. With this in mind, it is clear as to the portfolio allocations being concentrated in the fund that has the largest expected return. As a reminder, expected return is based on an average of yearly returns for the past 28 years.

Model Comparison

The Treynor approach yielded results that were vastly different than the Sharpe Ratio or Markowitz model. This can be attributed to how the Treynor Ratio is structured. It is structured to compare funds that are similar in systematic risk. With the convertible mutual funds having exposure to debt it is abundantly clear as to why they are trading at betas far below the index. As discussed earlier, debtholders are paid before equity holders in a bankruptcy event, meaning that debt has less risk than equity. Rather than having a return presented on a basis including systematic risk, it would make more sense to include entire volatility, both systematic and firm-specific risk. Additionally, it is important not to overlook covariance as the different funds have overlapping exposure to the equity markets. The Sharpe Ratio builds on where the Treynor Ratio fails to account for entire volatility. Furthermore, the Sharpe Ratio is better designed to compare funds with different volatilities and risk profiles while Treynor is more focused on funds with similar risk and volatility profiles. Where the Sharpe ratio falls short is covariance, which is covered by the more comprehensive Markowitz Model. While the Markowitz Model suggests that convertible debt should be considered in an optimal portfolio, the application of these findings will be discussed in the conclusion.

Conclusion

Findings

My data analysis exemplifies that exposure to convertible debt is not as optimal for the retail investor that would gain exposure through the mutual funds. This is apparent in the front load fees that detract from the alpha of such funds. When a retail investor gains exposure to the convertible debt mutual funds it is much more advantageous to invest over the long-term as it will leave them a longer period to cover the front load fee that was initially detracted from the principal. Even with the assumed 28-year holding period only the Markowitz Model suggests that convertible debt should be present in the optimal portfolio. Of the convertible debt mutual funds, the Markowitz model only recommends to invest in FISCX; this is interesting as this fund only has exposure to convertible debt from utility companies.

This could suggest that investing in convertible debt originating from certain sectors could be optimal. However, this could be a coincidence as FISCX is the highest performing convertible debt fund. An area for further research would be exploring performance of convertible debt in specific sectors. Tools such as a Bloomberg Terminal would be instrumental towards this, and even looking at specific issuances of convertible debt rather than funds that provide vast exposure. Unfortunately, when conducting my research, I did not have a Bloomberg Terminal at my disposal.

When examining the no front load iteration of my data the Sharpe ratio recommended a larger position in FISCX than any of the other convertible debt funds. However, the Markowitz Model recommended a larger position in PACIX despite it having a lower expected return than FISCX.

With the no front load iteration, the convertible debt funds clearly have a better fit within the portfolio. This illustrates that convertible debt is not as viable for an optimal portfolio when it comes to retail investors versus institutional investors. Even when retail investors invest in convertible debt, they will typically do this through a fund with management fees that make it that they must hold for a longer period to see an upside.

The potential argument that I acknowledged when beginning to analyze the data is that convertible debt could possibly act as a hedge to market crashes. However, this is in fact not the case. When looking at the Great Financial Crises of 2008 the index declined by approximately 38% with the convertible debt funds declining by 33% to 35%. The Dot Com crash of 2000 disputes this finding. While lasting from 2000 to 2002, the index declined by over 10% in 2000 while two out of the three convertible debt funds returned 15% to 16%. However, the two funds that reach this return only have exposure to utilities, energy, and real estate. Ultimately, they have no exposure to technology which makes it easier to understand why they didn’t also significantly underperform during the Dot Com crash that primarily impacted the technology sector.

To get a better understanding it would be more useful to isolate convertible bonds by sector to track performance relative to their equity counterparts. To narrow down performance even further using a tool, such as a Bloomberg Terminal, one could isolate individual convertible debt issuances and then view performance. Variables such as the delta between market price and strike price, time to expiration, and callability could be further isolated to discover the variables that play the greatest impact on convertible bond price. However, without individual issuances and prices of those issuances, using an index that captures a large section of the convertible debt market suffices.

Another area of concern is that the convertible debt mutual funds only capture a small subset of the entire convertible debt market. All of the mutual funds fall within the $1 billion to $5 billion range. Additionally, the convertible debt market is estimated by Putnam Investments to have $376 billion in market value. While I am using a sample, I am only capturing a small subset that I am not able to filter in any way. When it comes to the equity index, or the Wilshire 5000, this encapsulates every stock that is public in the United States.

Significance

When fees are not included convertible bonds have a place in the optimal model. When looking at the most comprehensive model in this paper, the Markowitz model asserts that a larger proportional investment in the convertible fund than the equity fund is warranted. Within the investment landscape convertible debt seems to be better suited for institutional investors that do not pay a front load fee. This includes hedge funds, and more generally portfolio managers.

This makes sense in the context of this paper and more broadly. As for this paper, I examined how convertible debt can be included in an optimal portfolio, or effectively acting as a hedge to common equity. Convertible debt is one of the tools that hedge funds use to gain debt exposure while maintaining equity upside. Especially when equity has a subordinate claim on assets, it is wise to also have debt exposure in an optimal portfolio. This is all despite having a standard error of greater that .1 which would indicate no statistical significance. However, with a lower beta it is implied that the convertible debt mutual funds will underperform the equity benchmark. This represents my null hypothesis. However, by not achieving statistical significance I am unable to dispute the claim of inferior returns by the convertible funds. Furthermore, increasing sample size would be critical to move forward in a direction that can achieve statistical significance. Going back to the idea of a Bloomberg Terminal, this would be pivotal in increasing sample size and furthering this study.

Besides hedge funds, convertible debt is also prevalent when examining venture debt lenders and start-up financing. These companies tend to be fast-growing industries, are not yet achieving positive net income, and lack collateral for asset-backed lending. Venture debt lending is not quite convertible debt, but highly similar. As discussed in the literature this type of lending is a hybrid security, providing debt and equity exposure, it often used by companies that may have limited options. With venture capital, which means investing in start-ups, capital is scarce and often difficult for start-ups to acquire. Firstly, by being new with little physical assets taking on straight debt would present an enormous risk. The way this risk is overcome is by giving debtholders first lien on debt (Demil et al, 2016). However, this presents limited return and is where venture debt lenders may include a warrant portion to act as a hybrid security.

The venture debt lenders (VDLs) also have a shorter time horizon than common equity investors, which aligns with entrepreneurs that are inclined to take risk and grow their companies. Rather than investing in hybrid securities, such as convertible debt, from the retail sense it makes more sense to do this on the institutional side. Additionally, when short-term returns are the goal, this approach is apt. However, if an investor is willing to have a longer holding period, there could be some place in an optimal portfolio for convertible debt.

Bibliography

Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy*, *81*(3), 637–654. https://doi.org/10.1086/260062

Cariola, A., La Rocca, M., & La Rocca, T. (2005). Overinvestment and underinvestment problems: Determining factors, consequences and solutions. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.835364

Damodaran, A. (2024, January). *Ratings, interest coverage ratios and default spread*. Ratings and Coverage Ratios. https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ratings.html

Elbannan, M. A. (2014). The Capital Asset Pricing Model: An overview of the theory. *International Journal of Economics and Finance*, *7*(1). https://doi.org/10.5539/ijef.v7n1p216

Fischer, T., & de Rassenfosse, G. (2011). Venture Debt Financing: Determinants of the lending decision. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1909602

Hayes, A. (2022, February 1). *Ft Wilshire 5000 index (FTW5000): Definition and what's included*. Investopedia. https://www.investopedia.com/terms/w/wilshire5000equityindex.asp

III, W. N., Glascock, J. L., & Schwartz, T. V. (1995). Signaling with convertible debt. *The Journal of Financial and Quantitative Analysis*, *30*(3), 425–440. https://doi.org/10.2307/2331349

Lewis, C. M., Rogalski, R. J., & Seward, J. K. (1999). Is convertible debt a substitute for straight debt or for common equity? *Financial Management*, *28*(3), 5–27. https://doi.org/10.2307/3666180

Lyandres, E., & Zhdanov, A. (2013, July 5). *Convertible debt and investment timing*. Journal of Corporate Finance. https://www.sciencedirect.com/science/article/abs/pii/S0929119913000564

Markowitz, H. M. (1976). Markowitz revisited. *Financial Analysts Journal*, *32*(5), 47–52. https://doi.org/10.2469/faj.v32.n5.47

Mikkelson, W. H. (1981). Convertible calls and security returns. *Journal of Financial Economics*, *9*(3), 237–264. https://doi.org/10.1016/0304-405x(81)90027-1

Nitzsche, D., Cuthbertson, K., & O'Sullivan, N. (2006). Mutual Fund Performance. *SSRN Electronic Journal*, 2–9. https://doi.org/10.2139/ssrn.955807

Salvin, R., Daigle, A., & Hughes, C. (2022, October). The convertible bond market. https://www.putnam.com/literature/pdf/TL914_IN.pdf

Sharpe, W. F. (1998). The Sharpe Ratio (Fall 1994). *The Journal of Portfolio Management*, 169–178. https://doi.org/10.1515/9781400829408-022

Spiess, K. K., & Affleck-Graves, J. F. (1996a). The long-run performance of stock returns following debt offerings. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2116

Stein, J. C. (1992, March). *Convertible Bonds as Backdoor Equity Financing*. Harvard.edu. https://scholar.harvard.edu/files/stein/files/convertibles-jfe-aug-92.pdf

Verma, Dr. M., & Hirpara, Mr. J. (2016). Performance evaluation of portfolio using the Sharpe, jensen, and Treynor Methods. *Scholars Journal of Economics, Business and Management*, *3*(7), 382–390. https://doi.org/10.21276/sjebm.2016.3.7.4