YIELD ESTIMATION TECHNIQUES

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Abstract

A debt agreement is a contract between the lender and the borrower, where the borrower borrows a certain notional amount at a pre-defined interest rate structure from the lender under mutually agreed terms and conditions. At any point in time, if the lender or the borrower wants to determine the value of the contract, they need to first estimate its yield which is typically a challenging prospect. To address this issue, the paper proposes various techniques to estimate the yield including the sister security approach, the yield trending approach, yield build-up, yield-to-worst and yield based on capital structure.

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1 Introduction

A debt agreement or debt security is a contract between the lender and the borrower where the borrower borrows a certain notional amount at a pre-defined interest rate structure from the lender under mutually agreed terms and conditions. The general inputs and outputs of a debt security valuation are defined in the Appendix. This white paper covers various techniques to estimate the yield used to discount the cash flows of a debt security.

1.1 Debt

The two most common sources of funds on an organization's balance sheet are debt and equity. Debt and equity can be raised from the market, from individuals or other organizations. Based on its functionality, debt can be categorized as follows:

- Long Term vs Short Term
- Callable/Puttable vs Non-callable/Non-Puttable
- Convertible vs Non-Convertible
- Tradable vs Non-Tradable (Public vs Private)
- Fixed Rate vs Floating Rate

Most of the above terminologies are agreed upon while entering into the agreement between the lender and borrower.

1.1.1 Long-Term vs Short-Term

A debt is called short-term debt if the maturity is less than a year and long-term debt if the maturity is greater than one year.

1.1.2 Callable/Puttable vs Non-Callable/Non-Puttable

In case of a callable/puttable debt, the borrower/lender has the right to retire/redeem the debt fully or partially before the stated maturity. This is not the case with non-callable/non-puttable debt.

1.1.3 Convertible vs Non-Convertible

Convertible debt (or a convertible debenture if it has a maturity of greater than 10 years) is a type of debt that can be exchanged for a certain amount of common stock in the issuing company. The conversion takes place based on the conversion price or conversion ratio specified in the debt agreement. Convertible debt is typically callable by the issuer. This allows the issuer to force conversion and limit the equity upside for investors.

1.1.4 Tradable vs Non-tradable (Public vs Private)

Debt traded in the market where market participants determine its appropriate value is called traded debt whereas debt that is issued to a single or a group of counterparty companies or organizations is considered non-tradable debt.

1.1.5 Fixed vs Floating

A debt's coupon is the periodic interest payment made to the lender during the life of the debt. The payment frequency is specified in the agreement. The debt can be broadly classified as fixed type and floating type based on the nature of the coupon payments. In case of fixed type, the coupon rate is fixed for the entire life of the debt. In case of floating type, the coupon rate resets at designated dates based on some reference rate (such as LIBOR, PRIME etc.) and typically adjusted by a spread.

2 Valuation Methodology

In order to determine the value of debt, it is always advisable to confirm that the debt is covered by the Business Enterprise Value (BEV) of the company. BEV can be determined using the market approach, income approach, cost approach, etc. The fair value of the debt security can be determined using the following methodologies:

2.1 Waterfall Method

The waterfall method is also called liquidation method or Enterprise Value (EV) coverage analysis. This method is used when BEV is not sufficient to cover all types of debt (Senior, Mezzanine, Subordinate, etc.) and when the company is under stress/ default. In this approach, a BEV is assigned to the debt portfolio based on seniority of the debt until there is enough value to cover the debt. i.e., the BEV is assigned to the debt portfolio until the entire BEV is liquidated/exhausted. Therefore, the BEV used to cover the debt is the value of the debt as of the valuation date under consideration.

2.2 Recent Transactions

If there is a recent transaction for the same security at a certain price, that price determined based on the sale is considered as the appropriate value for the investment.

2.3 Discounted Cash Flow Method

A discounted cash flow (DCF) method is a valuation method used to determine the present value of any investment. DCF analysis uses future cash flow projections and discounts them to arrive at a present value estimate.

$$PV = \sum_{i=1}^{T} \frac{CF_i}{(1+r)^{t_i}}$$

where,

CF_i is the cash flow paid at the end of interval i or at time t_i.

r is the yield to maturity.

t_i is the time interval from valuation date to cashflow date.

T is the maturity date.

3 Input Variable Calibration

3.1 Cash Flows

The amount of cash that needs to be paid out or flows in, which are projected till maturity. Each cash flow is discounted using the yield to arrive at the present value of the contract.

3.2 Discount Rates (Yield/Weighted Average Cost of Capital (WACC))

The yield to maturity or discount rate used to discount cash flows. The yield for a security can be determined based on whether the security is tradable or non-tradable in the market.

3.2.1 Market Sources

If the security is traded in the market, the yield can directly be sourced from the market from a variety of sources that include:

- Bloomberg
- Reuters
- Capital IQ
- Bank of America Merrill Lynch
- SNL
- S&P Leveraged Commentary & Data

3.2.2 Sister Security Approach

If there is a tradable security issued by the subject company or its sister company, the security is considered as sister security. A seniority premium or subordinate discount is added to/subtracted from the yield of the sister security based on its relative seniority to the subject security. This adjustment is determined by comparing similar securities traded in market based on seniority (leverage multiples etc.).

3.2.3 Yield Trending Approach

In this approach, the yield is determined based on a change in yield from the origination date to the valuation date for similar/equivalent securities (based on sector, credit rating, country of operation, etc.), sovereign securities, etc.

To calculate the yield at origination, the cash flows are projected from origination date to maturity date and are discounted using a discount rate such that the NPV of the cash flows equals the price at issuance.

3.2.4 Yield build-up

In this approach, the debt securities trading in the market that have similar/equivalent characteristics (credit rating, sector, country of operations, etc.) are considered. A median of the yield of these comparable securities is taken for valuation of the debt.

3.2.5 Yield Based on Capital Structure

The yield determined from the shadow rating (Refer Section 3.3.2) can be used to estimate the yield of a fixed income security based on the seniority/subordination in the capital structure. The white paper "Yield Estimation of Private Debt for a given Capital" [1] states that the yield for different levels of fixed income securities in the capital structure can be estimated as

$$Y_i = Y_c \left[1 + p_i \left[\frac{Debt}{Total\ Capital} \right] \right] + \alpha$$

where,

Y_i is the yield of the security.

Y_c is the corporate yield obtained from the shadow rating analysis.

α denotes the company specific factors.

p_i is the midpoint of the position of the security in terms of the capital structure (in percentage) i.e., the mid-point is the average of the cumulative sum of senior tranches with and without the tranche under consideration. For example, if an issuer has three instruments in its liabilities i.e., First Lien tranche, Senior Unsecured tranche and the equity with balances of USD 20, USD 50 and USD 30, respectively. The cumulative percentage balances of each tranche will be 20%, 70% and 100%, respectively. The mid-point of First Lien tranche is (0% + 20%)/2 = 10%, Senior Unsecured tranche is (20% + 50%)/2 = 35% and for the equity it is (70%+30%)/2 = 50%. Refer [1] for more details.

3.2.6 Yield-to-Worst

In this method, the worst yield is determined by forecasting different cash flows for each call date (including the maturity date). Based on each cash flow, the yield for which the estimated price is equal to the call price is determined. This is mainly used for contracts with embedded callable or puttable options.

The yield can also be determined using rating of the debt contract. The approaches used to determine the rating are discussed in detail below in Section 3.3.

3.3 Security Rating

The yield can be determined based on the ratings of the securities. Below are two different ways of determining the rating of a security.

3.3.1 Market sources

Security ratings can directly be sourced from market from one or more of the following sources if available:

- Bloomberg
- Reuters
- Capital IQ
- Bank of America Merrill Lynch
- SNL
- S&P Leveraged Commentary & Data

3.3.2 Shadow Rating

Shadow rating is an approach to determine the rating of the bond issuing company for a private placement. The rating is determined by considering financial ratios of the issuing company based on available financials.

The ratios can be broadly classified into three categories as shown below. It is a good practice to use at least one ratio from each of the three categories while determining the credit rating of the investment.

- Liquidity coverage
- Profitability
- Leverage ratios

As per an article on “Updated Summary Guidance for Notching Bonds, Preferred Stocks and Hybrid Securities of Corporate Issuers” published in February 2007 by Moody’s Investor Service (Global Credit Research) [2], the corporate credit rating obtained using the shadow rating approach would be equivalent to the credit rating of senior

unsecured debt issued by the entity. For the securities senior/junior to the senior unsecured debt the security rating can be obtained by notching up/down the security rating of senior unsecured debt.

3.4 Premium/Discount Applied on Yield based on Qualitative Factors

3.4.1 Liquidity Risk Premium

Liquidity Risk is the risk that the investor will have to sell a debt below its true value where the true value is indicated by a recent transaction. Liquidity risk is more of a concern for an institutional investor who plans to sell the debt before maturity and periodically marks to market as compared to an investor who holds the debt until maturity and need not mark a position to market, which is based on the contract/product specifications. Generally, large private equity players are required to mark their debt investments to market for financial reporting purposes. Institutional investors generally invest in high risk, low liquidity investments and receive a higher yield in return to compensate the liquidity risk. These investments generally fall at the lower end of the credit risk spectrum i.e. BBB rating and below and are categorized as high yield investments.

The exit price of a debt security is adjudged from a market participant perspective. It is important to adequately capture the liquidity risk while fair valuing a debt as not doing so may distort the fair value significantly. A liquidity risk premium is added to the discount rate as the investors would demand higher return form the issuer when they are not confident about their ability to shift from one financial asset to another based on requirement. Debt that do not trade often are marked to market by reference to the price of comparable debt with same or similar credit quality and maturity that traded on that day or by benchmarking against market indices which constitute such debt. A liquidity premium is added to the discount factor based on market research studies and is then used to calculate the fair value of the debt instrument. However, liquidity premium is not included in cases where a debt is issued at a discount as the liquidity premium is already factored in the internal rate of return (IRR) at issue. In such cases, the yield trending approach using comparable debt and suitable indices is followed so as to capture the movement between the issuance date and maturity and subsequently applying that change to the IRR at issue to determine the appropriate discount rate as of the valuation date.

Further studies can be performed to determine any additional factors like default risk premium, etc.

3.5 Maturity Date

The date on which the contract matures. For a callable/ puttable security the maturity date varies due to the inherent possibility of redemption of the contract.

3.5.1 Redemption Date

The redemption date is the date on which the debt is expected to be paid out or redeemed based on current forecasts of balances, interest rates, etc. The redemption date is equal to the maturity date for a non-callable debt security. For a callable debt security, given that there are different call dates and call /put prices, there is a possibility that the debt might get paid off before the contractual maturity date. The redemption date can be determined using yield-to-worst method and the date on which least or worst/best yield is observed is assumed to be the redemption date.

3.5.2 Time Path: Relationship between Price and Time to maturity for a given yield

The price of a debt shares an inverse relationship with the required yield at any given time. However, for a given yield, a change in the price of the debt is dependent on whether it was issued at par, a premium or a discount. With an assumption that the yield for a debt does not change between the issue date and maturity, a debt which was issued at par shall continue to sell at the par value as we approach the maturity date. There are cases where a debt is issued at a discount to its par value, known as original issue discount (OID) or at a premium to its par value. The price of such debt will not remain constant. For discounted debt the price will increase, and for debt selling at a

premium the price declines as it moves towards maturity assuming that the required yield remains same between the issue date and maturity.

4 Conclusion

This paper attempts to address the challenge of estimating the yield used for discounting the cash flows of debt securities. A number of yield estimation techniques are discussed above including the sister security approach, the yield trending approach, yield build-up, yield-to-worst and yield determination based on capital structure. Based on the availability of data and the type of debt security one of the above mentioned yield estimation techniques can be used to determine the value of the security.

5 References

[1] Rajesh Khetan, Pavitra Padhi and Dhruva Phegade, Yield Estimation of Private Debt for a given Capital, Risk Intelligence – GARP, 2018.

[2] Moody's Investor Service (Global Credit Research), Updated Summary Guidance for Notching Bonds, Preferred Stocks and Hybrid Securities of Corporate Issuers, 2007.

6 Appendix

6.1 Inputs

Contractual

- **Principal or Notional or Face Value or Par Value**: The amount that needs to be paid at the maturity of the bond.
- **Valuation Date**: Base date as of which the debt is being valued.
- **Maturity Date**: The contractual maturity date of the debt security under consideration.
- **Origination Date**: The date on which the debt gets originated.
- **Next Repricing Date**: The next date on which interest rate resets if the underlying debt security is tied to floating interest rate curve like LIBOR, etc.
- **Next Interest Payment Date**: The date on which next interest payment takes place.
- **Next Principle Payment Date:** The date on which next principle payment takes place.
- **Next Amortization Date** The date on which next amortization cash flow takes place.
- **Initial Investment:** The investment amount at origination
- **Current Investment:** The investment amount as of valuation date
- **% hold:** the percentage of debt held by the subject company
- **All – in – Rate:** The overall coupon rate of the debt security
- **Repricing Tenor (if floating):** The tenor of the repricing curve. For example, 3M for 3M LIBOR, 6M for 6M LIBOR, etc.
- **Interest Payment Frequency:** The frequency at which interest is paid.
- **Repricing Frequency:** The frequency at which the debt security reprices if it is a floating instrument.
- **Principle Payment Frequency:** The frequency at which the principle is paid
- **Amortizing Frequency:** The frequency at which the debt amortizes.
- **Yield determination (Pre/Post):** Confirmation of rate used for interest cash flows. For example, if the quarterly interest is paid on 31st march, the yield/coupon is used for calculation is as of 31st march or 31st December.
- **Accrual:** The accrual used for calculation of interest payment. It could be 30/360, 30/365, 30/Actual, Actual/360, Actual/365, Actual/Actual, etc.
- **Accrual (Discounting):** The accrual used for discounting the cash flows. It could be 30/360, 30/365, 30/Actual, Actual/360, Actual/365, Actual/Actual, etc.
- **Holidays:** List of holidays under consideration for the valuation of debt.

Note: The difference between principle payment and amortization cash flow is optionality like prepayments.

Optionality (Callable/ Puttable)

- **Call/Put price(s):** The price at which debt is callable by the debt issuers/ buyers.
- **Call date/ Put date(s):** The date on which debt is callable by the debt issuers/ buyers.
- **Prepayment Speed:** The expected speed at which the debt is prepaid.
- **Next Prepayment Date:** The date on which the next prepayment is expected.
- **Prepayment Frequency:** The expected frequency at which prepayments are expected.
- **Redemption Date:** The date on which the debt security is expected to mature for a callable debt investment. It can also be termed as expected maturity date.

6.2 Outputs

Vanilla

- **Fair Value:** The present value of all the future cash flows is considered as dirty price. Fair value is also called as dirty price.
- **Duration:** Duration is the change in price of debt for unit change in interest rate.
    1. **Macaulay Duration (MD):** The weighted average term to maturity of the cash flows from a debt. The Macaulay duration is given by,

$$MD = \frac{\sum_{t=1}^{n} \frac{t * C}{(1+r)^t} + \frac{n * M}{(1+r)^n}}{Current\ Bond\ Price}$$

    2. **Modified Duration:** Modified form of Macaulay Duration, this captures the change in value of the debt with change in interest rates and it is given by,

$$Modified\ Duration = \frac{MD}{\left(1 + \frac{r}{n}\right)}$$

    3. **Key Rate Duration (KRD):** This measure change in value of the debt for 1% change in yield of a specific maturity across the yield curve while keeping the yields for other maturities constant.
- **Convexity**: Convexity is the change in duration for unit change in interest rate. This captures the disproportional change in yield with respect to maturity.

Optionality (Callable/ Puttable)

- **Effective Duration:** Duration of a callable/puttable debt approximated using modified duration of the debt, which considers change in expected cashflows with change in interest rates.
- **Spread Duration:** Change in the price of debt to change in Option Adjusted Spread (OAS).

Dirty Price vs Clean Price

The payment settlement for a debt happens a day after the coupon date. Generally, a debt is purchased in between two coupon dates so that the next coupon payment is less than the contractual interest payment period. Similar situation occurs when we try to value a debt as of a given valuation date which typically falls between two coupon dates making the period between the valuation date and the subsequent coupon payment date to be less than the contractual coupon period. When the debt is between the coupon paying dates, the investor earns accrued interest which increases until the next coupon payment date. This brings us to the concept of dirty and clean price of the debt.

- **Dirty Price:** Dirty price is the price of debt including any interest that has accrued since issue of the most recent coupon payment. It includes the portion of the coupon interest that the debt buyer will receive but that belongs to the seller. From a valuation perspective, dirty price would reflect the portion of the coupon which has already been received notionally by the investor before the valuation date.
- **Clean price**: A clean price equals the discounted future cash flows of the debt excluding the accrued interest till the settlement/valuation date. Immediately following the coupon payment, the clean price and dirty price will be equal and the accrued interest resets to zero.

$$Dirty\ Price = Clean\ Price + Accrued\ Interest$$

  The clean price compensates the seller for the portion of the next coupon interest payment which is owed to the seller but will be received by the buyer. From a valuation standpoint, clean price excludes the accrued interest since the last coupon date to the valuation date and reflects the fair value of the debt as of the valuation date by only capturing interest accrued post valuation date.