Using Structural Models for Credit Investment

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Disclosure

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Structural Models and Credit Risk

- Black & Scholes (1973) noted that their option pricing models can be used to price risky debt.
- Merton (1974) developed this further by applying it to a hypothetical company's capital structure.
- The original approach is highly restrictive:
  - Assume debt is zero coupon bonds
  - Default can only occur on debt maturity date (i.e. European options)
  - No dividends

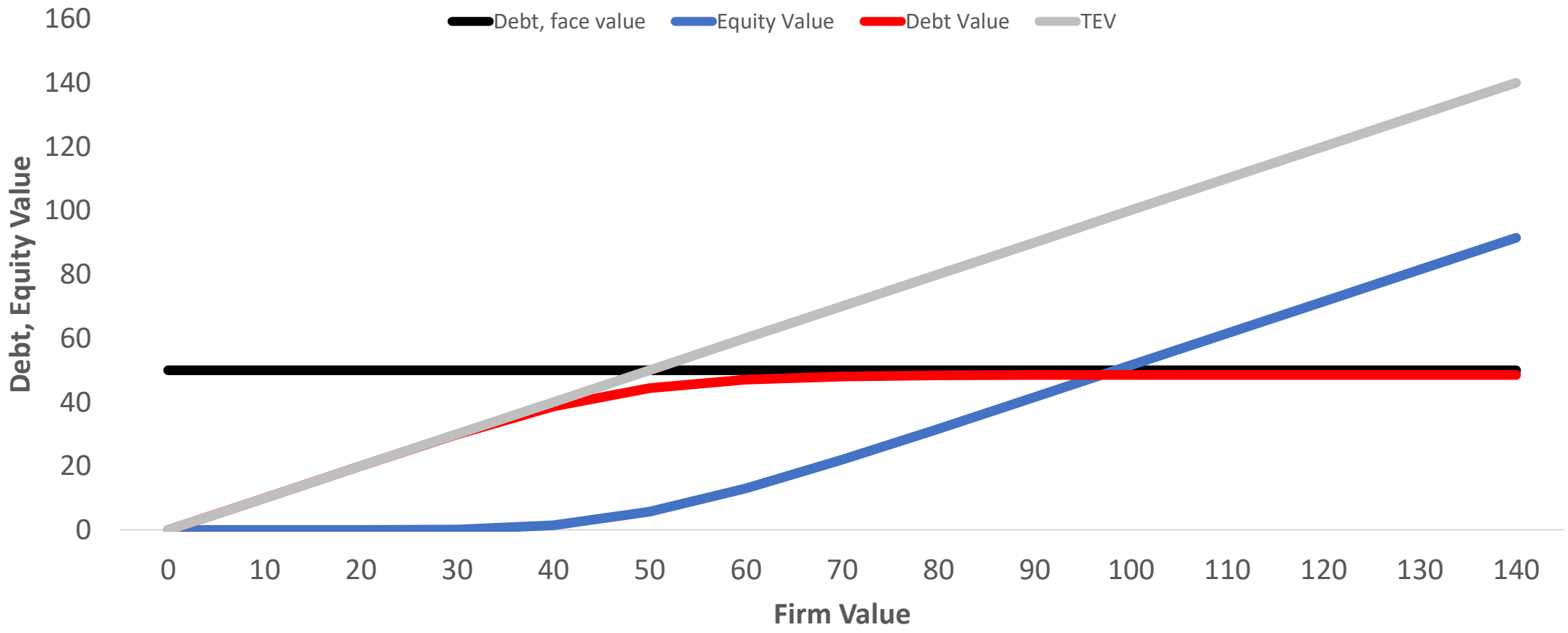
Structural Models and Credit Risk

- Further attempts were made to lift some of the restrictions:
  - Bond indentures, (Black & Cox, 1976)
  - Coupon paying debt (Geske, 1977)
  - Stochastic interest rates (Longstaff & Schwarz, 1995)
  - Endogenous bankruptcy process (Leland & Toft, 1996)
- Performance of all models remains poor when tested in the real world (Jones (1984), Ogden (1987), Sarig & Warga (1989), Ericsson & Reneby (2004), and Eom (2004)).
- Commercial Applications: Moody's KMV, Bloomberg, etc.

Underlying Rationale

- In a limited liability company, creditors have to be paid in full before shareholders are entitled to any value.
- It follows that when debt is due for repayment:
  - If the total **value** of the **firm** is **less** than the **debt** due, shareholders walk away, the firm defaults and creditors sell the assets to gain some recovery.
  - If the total v**alue** of the **firm** is **more** than the **debt** due, shareholders pay the creditors and take the residual value for themselves.

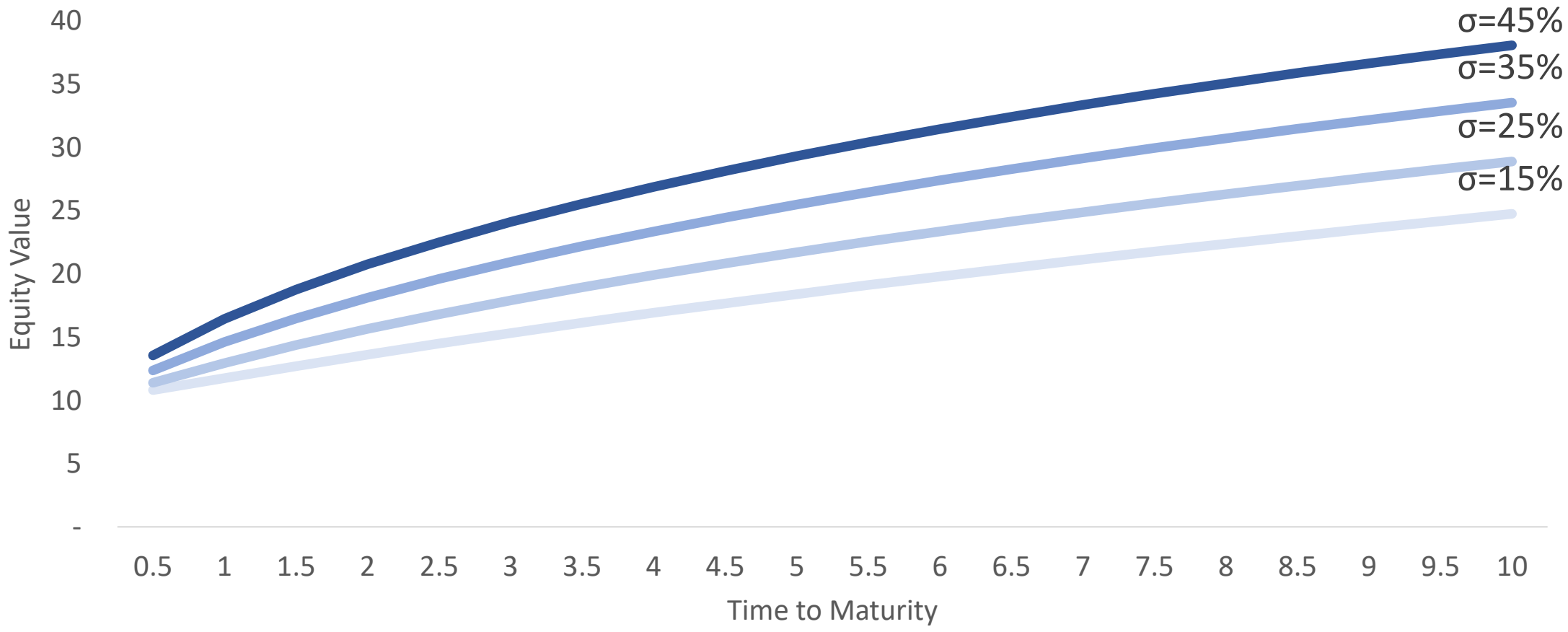
Pay-off functions



Pay-off functions

- Equity's pay-off function is the same as a CALL OPTION on the firm's assets, with strike price = firm's liabilities.
- Debtors' pay-off function is the same as SHORTING A PUT OPTION on the firm's value, with strike price = firm's liabilities.

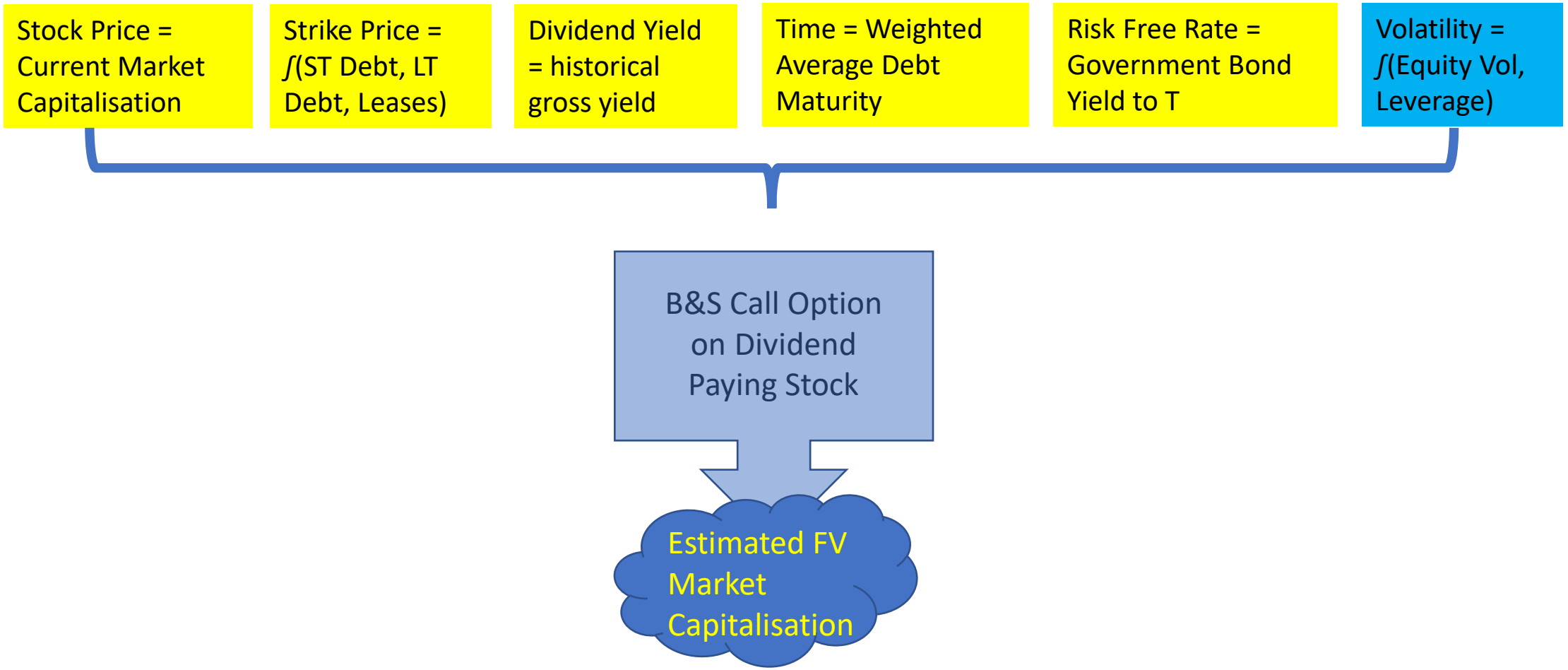
Capital Structure Insights – Equity Value



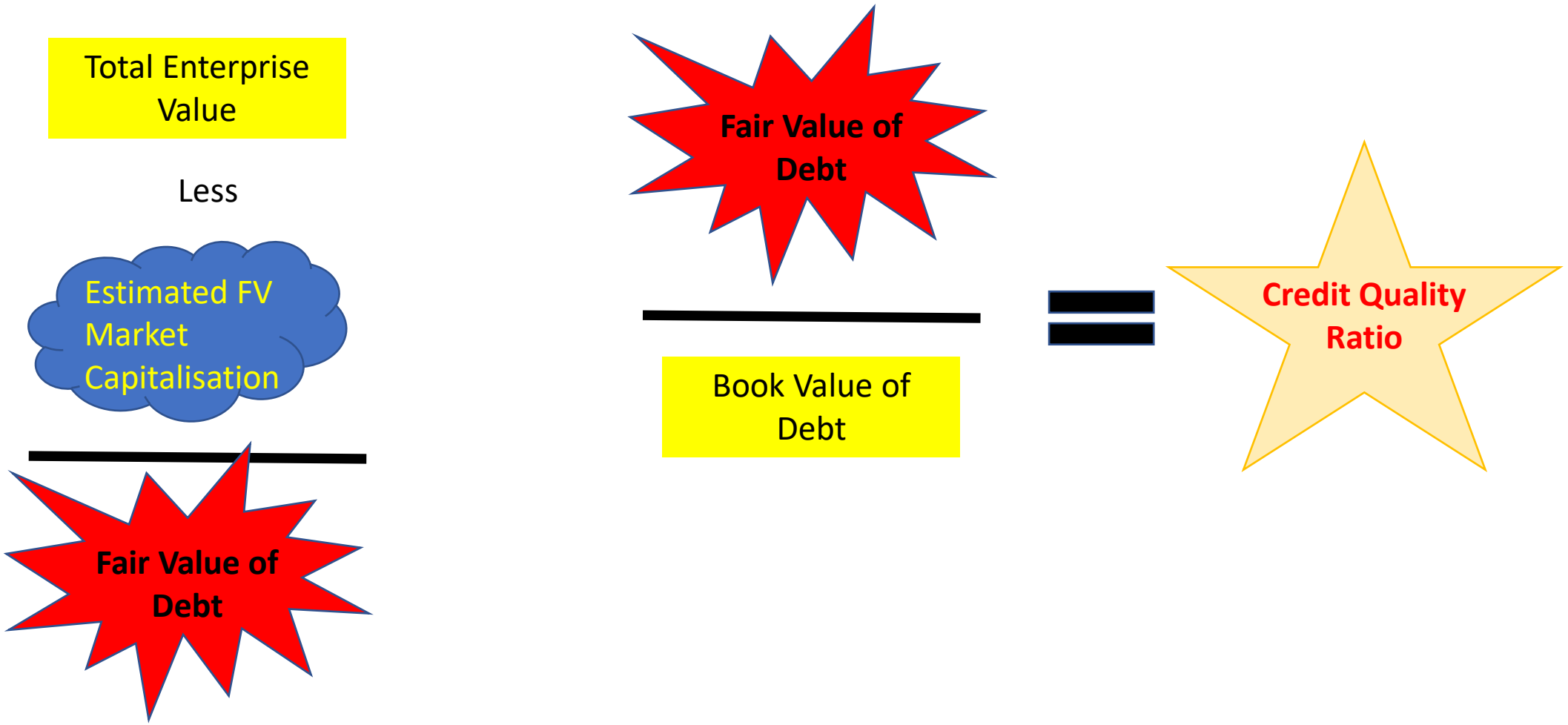
Practical Applications

- Obstacles:
  - Implementation is very difficult
  - Some inputs are unobservable and must be estimates
  - The accuracy of structural models' pricing is inversely related to the firm's credit quality.
- Opportunities
  - Keep the model simple
  - Calculate a credit quality score, not fair value
  - Use results for comparatively

Implementation: Equity Valuation



Implementation: From Equity Value to Credit Quality

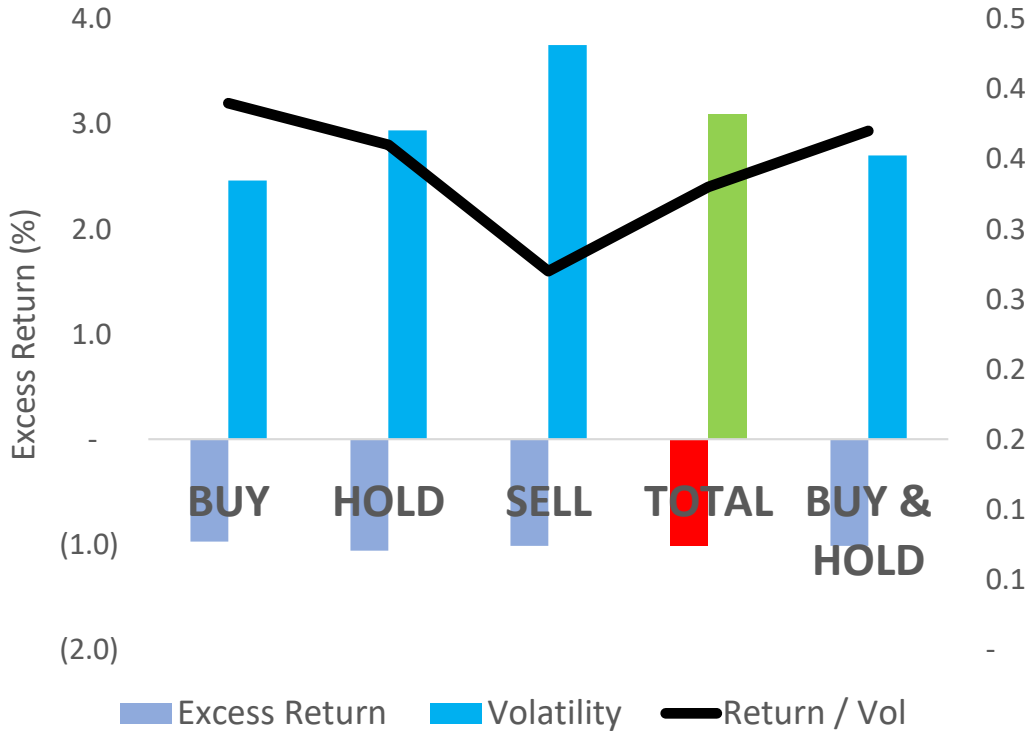


Theory is great, but does it work?

- Calculate the Credit Quality Ratio for publicly listed non financial companies in the Barclays Euro Aggregate Index:
  - 2015: 313 bond issuers
  - 2016: 304 bond issuers
- Data used as if user selects investments 2 months before the investment year begins.
- Rank the issuers by credit quality ratio
- Divide to three groups: BUY = top 1/3, HOLD = middle 1/3, SELL= bottom 1/3

Testing the model – risk-based selection

2015



2016

Takeaways

Results

- There are no free lunches – low volatility assets beget lower returns
- The BUY bonds provide the best Reward/Risk profile
- BUY + HOLD bonds provide better Reward/Risk than total population

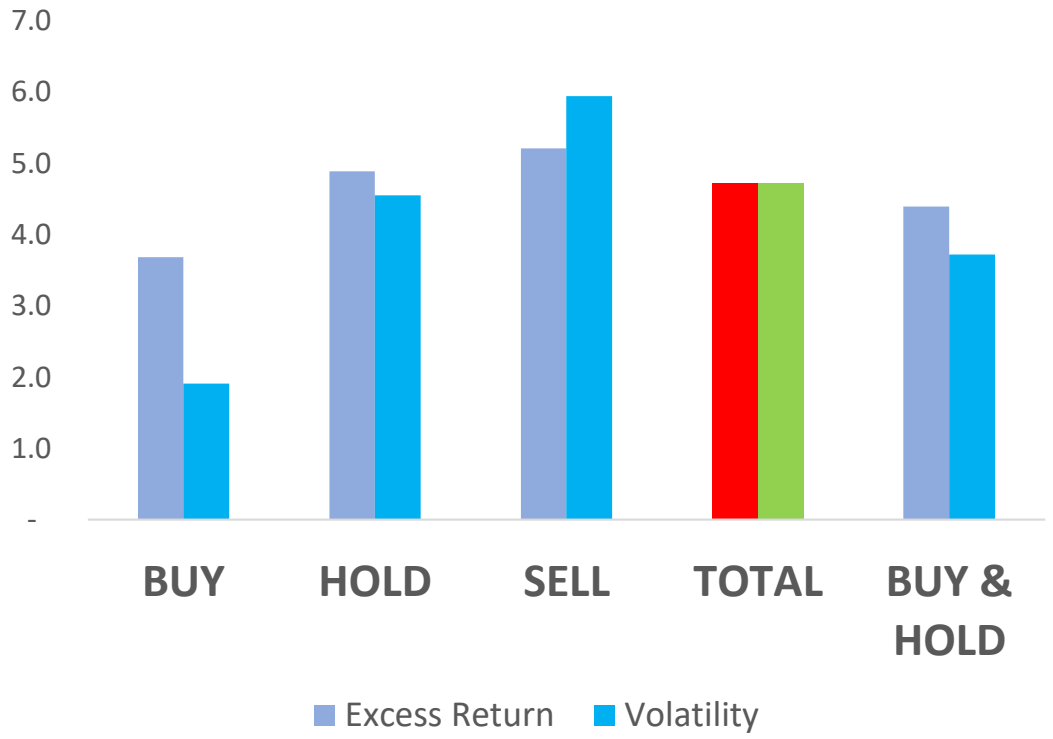
Improvements

- Add risk premium as a selection criteria – select only bonds that offer above average spreads.

Testing the model – risk & reward selection

2015

2016



Volatility: Risk v. Risk & Reward

Risk Only tends to favour lower volatility bond selection

2015

2016

Excess Return: Risk v. Risk & Reward

Risk Only tends to favour lower excess returns

2015

2016

Observations

- BUY-ranked bonds offer superior risk/reward to HOLD and SELL rated bonds.
- BUY and HOLD bonds offer superior risk/reward compared with the total sample.
- Using both Risk and Credit Spreads as selection criteria tends to lead to higher returns but also higher volatility of returns.
- Both Risk Only and Risk & Reward Selection Criteria tend to lead to superior risk/reward selection compared with the total sample.

THANK YOU!