Lecture 12

Capital Structure

Capital Structure Theory

- Capital Structure: How a firm finance –i.e., equity (E) or debt (D)- its assets

- Modigliani-Miller Theorem (MMT): Uses a simple model of valuation
  - No arbitrage –i.e., equal rates of return for equal risks.
  - Risk-free debt

- Under certain assumptions (perfect markets, no taxes or bankruptcy costs, no asymmetric information, etc.), the value of the firm (V) is independent of how the firm is financed.

$$V = D + E$$

- That is, there is no "optimal" capital structure.

- If MMT's assumptions are violated, then capital structure matters.

- Usual violations
  - Traditional finance: bankruptcy costs, agency problems, non-convex taxes, asymmetric information.
  - Behavioral finance: inefficient markets, managerial and investor behavor.

- Q: If MMT is violated, what is the "optimal" capital structure?

Main Theories

Trade-off Theory.
This theory can be obtained from different perspectives. Debt is "risky."

- Bankruptcy costs exist. There is a "tax-bankruptcy" trade-off for debt:
  - tax benefit
  - bankruptcy cost.

- There is an "agency" perspective:
  - Debt disciplines manager and mitigates agency problems of free CFs, since debt must be repaid to avoid bankruptcy. But, exacerbates shareholder-debtholder conflicts.

References: Jensen and Mekcling (1976), Jensen (1986), and Hart and Moore (1994)

- There is a "stakeholder co-investment" perspective:

  - Some firms efficiency requires a firm's stakeholders to make significant firm-specific investments. Firms making unique products will lose customers if they may go bankrupt.

  <u>Reference</u>: Titman (1984), Maksimovi and Titman (1991).

- <u>Note</u>: These perspectives differ from the "tax-bankruptcy" tradeoff. The costs of debt are from disruption to normal business operations and do not depend on the arguably small direct costs of bankruptcy.

- As a result of these three perspectives we have a general result

  = > Marginal benefit of debt declines as debt increases. There is an optimal capital structure, D/E*.
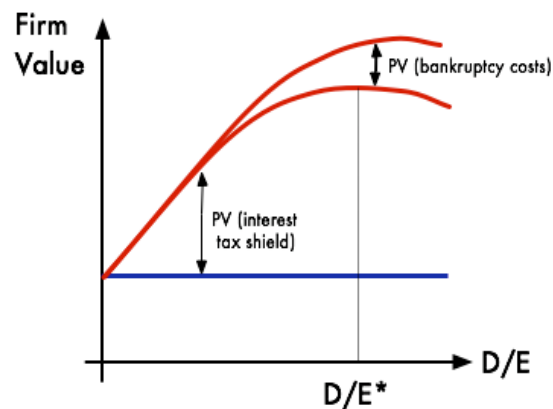
Pecking Order Theory

Asymmetric information exists and it is costly. Managers have more information about the quality of the firm.

• Companies select financing according to the law of least effort.
  (1) Internal financing (retained earnings), first.
  (2) Bank debt (in different levels, easiest: bank debt) , second
  (3) Equity, last resort.

   Adverse selection issues: Equity has a lot, debt a little, retained earnings none.
      => The choice of financing is a signal.

• Myers (1984): when equity is issued, investors think firm is overvalued (managers use the last resort tool, only because firm is overvalued). Investors demand a higher return on equity than on debt.

• References: Donaldson (1961), Myers (1984)

Market Timing Theory

Firms are indifferent between equity or debt financing. But, the market makes pricing mistakes from time to time.

• Managers select the debt or equity according to the relative mispricing. If neither market looks favorable, manager may defer issuances. If conditions look unusually favorable, managers may raise funds even if the firm has no need for funds.

• There are no firm specific variables ("factors") that influence D/E.

• Behavioral finance-type story.

• Baker and Wrugler (2002): Theory explains "hot" and "cold" IPO periods.

Managerial Inertia Model

Firms do not act to adjust capital structure.

      - When stock prices are high, firms have low D/E.

      - When stock prices are low, firm have high D/E

• There is no counter action to counterbalance stock return induced D/E changes.

• Welch (2004) finds that stock returns can explain D/E dynamics.

Stylized Facts

- <u>Fact 1</u>: Firms use debt financing too conservatively – Graham (2000), Strebulaev & Yang (2007).

- <u>Fact 2</u>: Negative relation between profitability and leverage - Myers (1993), Myers and Shyam-Sunder (1999).

- <u>Fact 3</u>: Firms mean-revert slowly towards target leverage –Fama and French (2002), Flannery and Rangan (2006).

- <u>Fact 4</u>: Changes in market leverage are largely explained by changes in equity prices -Welch (2004)]

- <u>Fact 5</u>: Leverage largely driven by unexplained firm-specific fixed effect - Lemmon, Roberts, Zender (JF, 2006).

- <u>Fact 6</u>: Link between governance mechanisms & leverage ambiguous - Berger, Ofek & Yermack (JF, 1997), John and Litov (2008).

Trade-off Theory

- Firms operate under a target D/E ratio, representing some "optimal D/E ratio."
- Firms do not instantaneously achieve their target D/E ratio.
- They adjust the actual D/E ratio over time. The model is called the *dynamic* trade-off model:

$$\Delta D_{i,t} = \gamma_i \left(D_{i,t}^* - D_{i,t-1} \right) + e_{i,t} \qquad (1)$$

where $D_{i,t}$ is firm i's realized D/E in period t, $D_{i,t}^*$ is firm i's target D/E ratio, Δ is the difference operator, γ_i is the partial adjustment coefficient (also called speed of adjustment); $0 \le \gamma_i \le 1$, and $e_{i,t}$ is a regression error.

• This model can be estimated using OLS.

• But the target debt-equity ratio, $D_{i,t}^*$, is unobservable:
  => it is not possible to directly test the dynamic trade-off model.

• A (usually ad-hoc) model for the target D/E ratio is used to estimate the model:

$$D_{i,t}^* = \beta' X_{i,t} \qquad (2)$$

where the vector $X_{i,t}$ contains a set of driving variables:
  - EAT
  - B/M
  - Marginal tax rate
  - Altman Z score
  - Industry dummy variables
  - Capital and/or R&D expenditure

• These variables are used because they are theory related or were used before (data mining problem).

• Then, the usual estimated equation becomes:

$$D_{i,t} = \gamma_i \beta' X_{i,t} + (1 - \gamma_i) D_{i,t-1} + e_{it}, \qquad (3)$$

This equation is in terms of observables. It is the basis of empirical work

• Unrestricted estimation of (3) is straightforward. But, only $(1-\gamma_i)$ will be estimated, γ_i cannot be recover from the unrestricted coefficient for $X_{i,t}$.

=>The speed of adjustment is estimated through the unrestricted coefficient of $D_{i,t-1}$.

• Note that a two-step estimation procedure could be used:
- First, estimate (2), using the observed $D_{i,t}$ as a proxy for the unobserved dependent variable, $D^*_{i,t}$.
- Second, with the estimated estimated $D^*_{i,t}$, do an unrestricted estimation of (3).

• Equation (3) is a standard panel data model. Usually, a common $\gamma_i = \gamma$ is estimated, assuming:
- Pooled data or Fama-Macbeth's method, Fama and French (2002).
- Fixed-effects model, Flannery and Rangan (2006).

• We can ignore the panel to allow for heterogeneity. (Trade-off: less powerful estimates of common parameters, but it allows for different γ_i's.
- Individual (i=industry) estimation, Roberts (2002), Zhao and Susmel (2008).

• Usual trade-off in panel: Panel estimation produces more powerful estimates, but at the cost of heterogeneity (the estimate may not be representative).

• **Main Findings**:
   - For the trade-off model: Hovakimian, Opler, and Titman (2001), Strebulaev (2004), Flannery and Rangan (2006), and Kayhan and Titman (2007) find that the dynamic trade-off model dominates alternative models.

   - Against the trade-off model: Fama and French (2002) find no clear cut dominant model.

   - Book value debt vs. Market value debt.
      => Marsh (1982): empirical results are not significantly affected by the choice.
      => Drobetz, Pensa, and Wanzenried (2007): market values calculations are cumbersome, not readily available and may not reflect changes initiated by firm's managers. (They call market value of debt "quasi-market" value of debt. Firms are more concerned with book D/E ratios.)

• **More Findings**:
   - Long term or Short term debt? Long term debt is less flexible. Partial adjustment model makes more sense for long term debt.
      => Flannery and Rangan (2006) use different definitions of debt. Results are not significantly different

   - Heterogeneity of γ is significant: Roberts (2002), Fama and French (2002), Flannery and Hankins (2007).
      => Fama and French (2002) report annual estimates of γ from 7% to 18%, Roberts (2002) reports for different industries annual estimates from close to 0% to close to 100%.

   - Target D/E ratio time-varying? Conflicting theory and evidence.
      => Mean reversion in actual D/E is found by Marsh (1982), Auerbach (1985) and Opler and Titman (1995).
      => Jalilvand and Harris (1984) find that D/E ratios are stable. Drobetz, Pensa, and Wanzenried (2007) find that book D/E is quite stable around .6, though market D/E tends to be more time-varying.

• Issues in Trade-off (and, in almost all Capital Structure) models

    - The estimated model is a reduced form model
            => identification problem.
  - Correct specification of model for $D^*_{i,t}$.
  - Measurement error may be an important issue.
  - Missing variables in the model for $D^*_{i,t}$ and thus in model for $D_{i,t}$.
  - Heterogeneous panel.
  - Autocorrelation and cross correlation in error terms.
  - Potential unit roots.

• **Testing the Trade-off Model**
Notice that the test of the trade-off theory would be straightforward if an estimate of $D^*_{i,t}$ were available. Simply rearrange the first equation:

$$D_{i,t} = \gamma_i D^*_{it} + (1 - \gamma_i)D_{i,t-1} + e_{it}$$

Usually, an unrestricted estimation of the above equation is done:

$$D_{i,t} = \gamma_{i,1} D^*_{it} + \gamma_{i,2}D_{i,t-1} + e_{it} \qquad (4)$$

Then, the test of the Dynamic Trade-off Theory is:
      H_0(Dynamic Trade-off Theory true): $\gamma_{i,1} + \gamma_{i,2} = 1$.
      H_1(Dynamic Trade-off Theory not true): $\gamma_{i,1} + \gamma_{i,2} \neq 1$.

• This direct test is never done. (This is why the empirical literature emphasizes the estimates of the speed of adjustment.)

• Usually, tests are done indirectly. A finding of a significant speed of adjustment is seen as evidence for the model –even though other models may also posit some autocorrelation for D/E; see Chen and Zhao (2005).

• The direct test, however, can be done. We need an estimate of $D^*_{i,t}$.
    => Kalman filter can do it.

• Assume $D^*_{i,t}$ follows an AR(1). Then, the model in (4) can be written in a state-space representation:

$$D_{i,t} = e_{i,t} + [\gamma_i \quad 1-\gamma_i] \begin{bmatrix} D^*_{i,t} \\ D_{i,t-1} \end{bmatrix} \qquad \text{(measurement equation)}$$

$$\begin{bmatrix} D^*_{i,t} \\ D_{i,t-1} \end{bmatrix} = \begin{bmatrix} \phi & 0 \\ \gamma_i & 1-\gamma_i \end{bmatrix} \begin{bmatrix} D^*_{i,t-1} \\ D_{i,t-2} \end{bmatrix} + \begin{bmatrix} u_{i,1t} \\ u_{i,2t} \end{bmatrix} \qquad \text{(state equation)}$$

•   Different assumptions about $D^*_{i,t}$ can be introduced by placing restrictions on φ.
    – Constant, by setting φ = 0
    – Random Walk, by setting φ = 1.

•   This approach avoids endogeneity issues (many of the $X_{i,t}$ variables are simultaneously determined with $D_{i,t}$.) and jointly directly estimates all parameters of interest.

•   More important, the direct test of the trade-off model –i.e., H_0: $\gamma_{i,1}$ + $\gamma_{i,2}$ = 1- can be done.

•   Zhao and Susmel (2008) do this.
    – They estimate the state-space representation for 578 firms, under three different assumptions for $D^*_{i,t}$: AR(1), constant, and RW.
    – The model is estimated for each firm.
    – Quarterly data, using firms with uninterrupted histories.

- **Findings**
  - Model holds for 32% of firms, assuming $D^*_{i,t}$ follows an AR(1).
  - Model holds for 52% of firms, assuming $D^*_{i,t}$ is constant.
  - A lot of heterogeneity in $\gamma_{i,1}$. For the AR(1) case:
    - Median $\gamma_{i,1}$ is .161, the average $\gamma_{i,1}$ is .276. (Quarterly estimates)
    - The empirical 95% C.I for $\gamma_{i,1}$ € [.025, .951]. The IQ range is not that extreme, going from .088 to .347