Leverage Dynamics under Costly Equity Issuance

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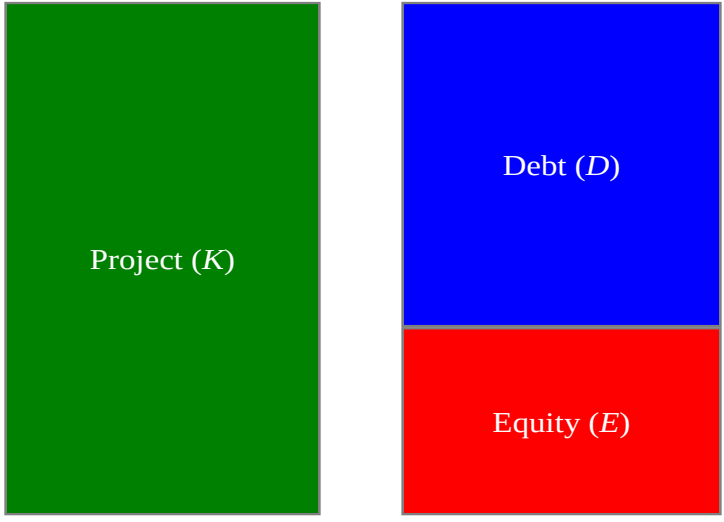
Capital Structure



Graham and Harvey (2001) Survey

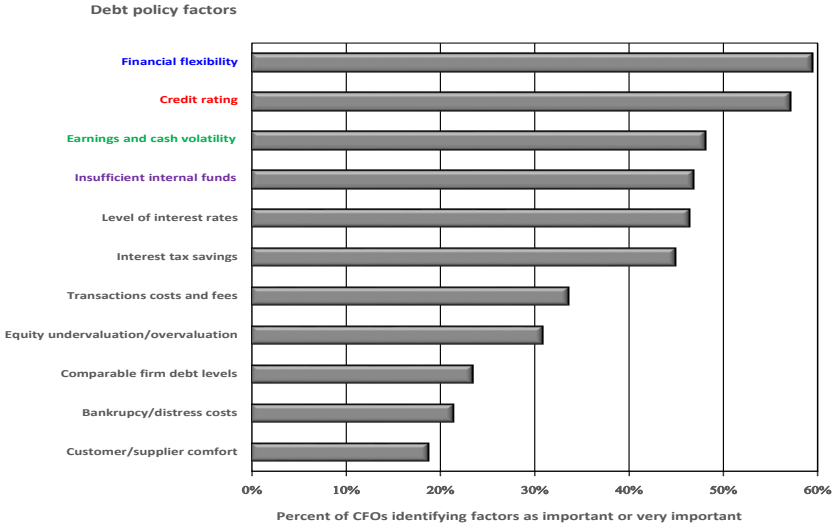


Fig.5. Survey evidence on some of the factors that affect the decision to issue debt. The survey is based on the responses of 392 CFOs.

Which factors drive debt decisions?

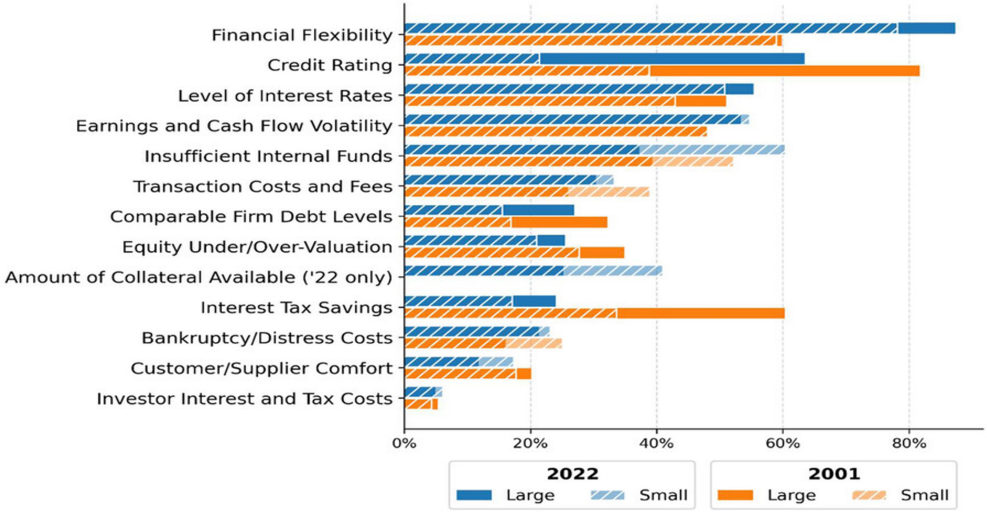


Figure: Figure 16 in Graham (2022) AFA Presidential Address.

Why is maintaining financial flexibility important?

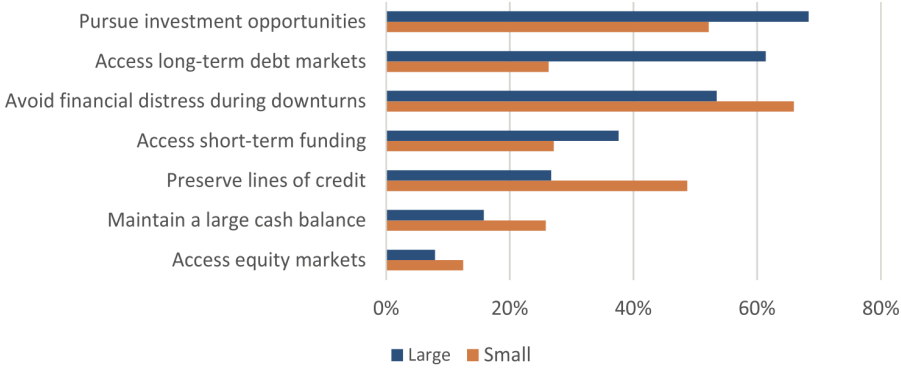


Figure: Figure 17 in Graham (2022) AFA Presidential Address.

What do we know about capital structure

- Firms **pay down debt when making profits, build up debt in response to losses**; payout important for leverage dynamics (DeAngelo, Gonçalves, and Stulz, 2018)

- "More profitable firms are less levered (leverage-profitability puzzle) and short-term variation in investment and earnings is mostly **absorbed by debt**" (Fama and French, 2002)

- Firms are **averse to and rarely issue equity** and when they do, they issue **lumpy** amounts; external debt financing driven by the internal financial deficit (Donaldson, 1961; Shyam-Sunder and Myers, 1999)

- Standard theories have hard time explaining these findings

Key features of Credible Theories

Subsection 7.8 in DeAngelo, Gonçalves, and Stulz (2018, RFS): "Corporate Deleveraging and Financial Flexibility":

> **7.8 Key features of credible theories**
> Viewed most broadly, our findings highlight the need for theories that (1) can explain why most firms proactively deleverage from peak to near-zero ML (and negative net debt) after having had similarly conservative financial policies before peak; (2) treat financial flexibility and the option to borrow as valuable, with debt used for transitory financing; (3) recognize the benefits of internally generated equity obtained through the retention of earnings; and (4) have important financial flexibility-related dependencies among leverage, cash-balance, and retention versus payout decisions.

What we do: Develop an Integrated Dynamic Capital Structure Framework

- Leading capital structure theories:
  - Tradeoff theory ⏩ Detail
  - Pecking-order hypothesis ⏩ Detail

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- Leading capital structure theories:
  - Tradeoff theory Detail
  - Pecking-order hypothesis Detail
- Integrating key features and insights from these two theories, we develop a tractable **financial-flexibility theory of capital structure** that generates predictions consistent with evidence

Related Literature is Vast

Understanding Dynamic Capital Structure in Three Steps

1. Develop a new time-variant **dynamic tradeoff theory**

2. Incorporate costly external equity:
   A financial flexibility theory of corporate policies

3. Endogenize investment and growth option exercising:
   A q and growth option theory of leverage dynamics

EBIT and Gordon Growth Model

- Earnings before interest and taxes (EBIT):

$$\frac{dY_t}{Y_{t-}} = \mu dt + \sigma d\mathcal{B}_t - (1 - Z) d\mathcal{J}_t\,, \quad Y_0 > 0$$

where a (downward) jump arrives with probability λ per unit of time (after risk adjustments, i.e., under the risk-neutral measure). If a jump occurs, i.e., $d\mathcal{J}_t = 1$, EBIT changes from Y_{t-} to $Y_t = ZY_{t-}$.

- Valuing EBITs:

$$\Pi(Y) = \pi Y\,,$$

where

$$\pi = \frac{1}{r - g} \quad \text{and} \quad g = \mu - \lambda(1 - \mathbb{E}(Z))$$

is the expected EBIT growth rate.

Jumps vs Diffusion Shocks

Debt Pricing: Markov Subgame Perfect Equilibrium

- The equilibrium interest payment is $C_{t-} = (r + \eta_{t-})X_{t-}$, where the equilibrium credit spread, η_{t-}, depends on the ratio $x_{t-} = X_{t-}/Y_{t-}$
- The zero-profit condition for creditors:

$$X_{t-}(1 + r dt) = (X_{t-} + C_{t-} dt) \left[1 - \lambda \mathbb{E}_{t-} \left(\mathbf{1}_t^{\mathcal{D}}\right) dt\right] + \mathbb{E}_{t-} \left(L_t \, \mathbf{1}_t^{\mathcal{D}}\right) \lambda dt \,,$$

  where $\mathbf{1}_t^{\mathcal{D}}$ is an indicator function: $\mathbf{1}_t^{\mathcal{D}} = 1$ if the firm defaults at t and $\mathbf{1}_t^{\mathcal{D}} = 0$ otherwise

- Market and face values of debt are the same until the firm defaults

Assumptions in Classic Tradeoff Theory

- **Financial Distress:** Under the standard assumption that the absolute priority rule (APR) holds, creditors receive the firm's liquidation value upon default at $T^{\mathcal{D}}$:

$$L_{T^{\mathcal{D}}} = \ell Y_{T^{\mathcal{D}}} .$$

  One example is: $L_{T^{\mathcal{D}}} = \alpha \Pi(Y_{T^{\mathcal{D}}})$ where $\ell = \alpha\pi$

- **Tax benefits of debt:** Corporate tax payment: $\Theta(C_t, Y_t) = \theta(c_t)Y_t$, where $c_t = C_t/Y_t$ and $\theta(c)$ is decreasing in c. A simple piecewise linear tax schedule: $\theta(c) = \tau(1-c)\mathbf{1}_{c<1}$ where $\tau > 0$ is the corporate profit tax rate and $\mathbf{1}_A$ is an indicator function
  - When making a profit ($Y_t > C_t$), the firm pays taxes
  - No tax loss carryforward and no personal taxes

1. Dynamic Tradeoff Theory

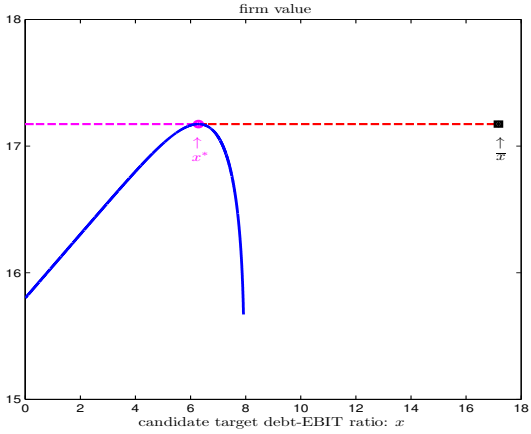


Figure: Target leverage is $ML^* = x^*/v(x^*) = 6.29/17.17 = 37\%$ (the magenta dot).

⏩ Calibration and Parameter Choices ⏩ Seven Parameters

⏩ Recall Static Tradeoff Theory

2. Add Costly External Equity Issuance

- Issuing (net) amount dN_t costs the firm:

$$\underbrace{h_0 Y_t}_{\textbf{fixed costs}} + \underbrace{h_1 \cdot dN_t}_{\textbf{variable costs}}$$

- Existing shareholders need to give up a fraction of their equity valued at $h_0 Y_t + (1 + h_1) \cdot dN_t$

- Demand for **financial flexibility**

⏩ Optimality

Sources of Funds = Uses of Funds $\longrightarrow$ Debt Dynamics

- Four controls drive debt dynamics:

$$dX_t = \underbrace{dU_t}_{\text{equity payout}} - \underbrace{[Y_{t-} - (C_{t-} + \Theta_{t-})]}_{\text{retained earnings}} dt - \underbrace{dN_t}_{\text{equity issue}} - \underbrace{(X_{t-} - L_t)}_{\text{creditors' default loss}} \cdot \underbrace{\mathbf{1}_t^{\mathcal{D}} \, d\mathcal{J}_t}_{=1 \text{ if default}}$$

  and map to the four regions: *payout*, *debt financing*, *equity financing*, and *default*.

- *"in the modified pecking order story, observed debt ratios will reflect the cumulative requirement for external financing–a requirement cumulated over an extended period"* (Myers, 1984)

Firm Value: $v(x) = p(x) + x$

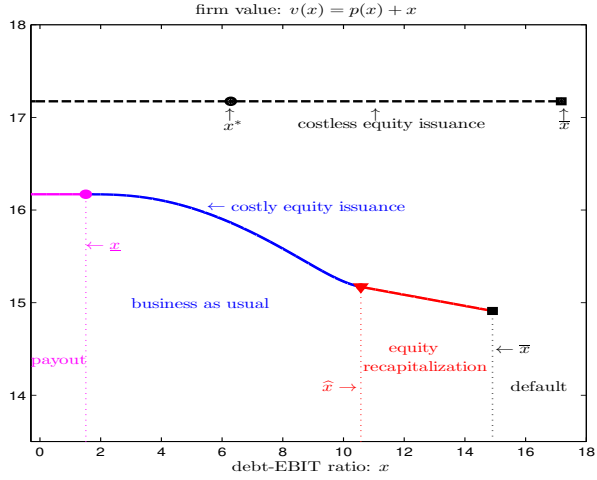
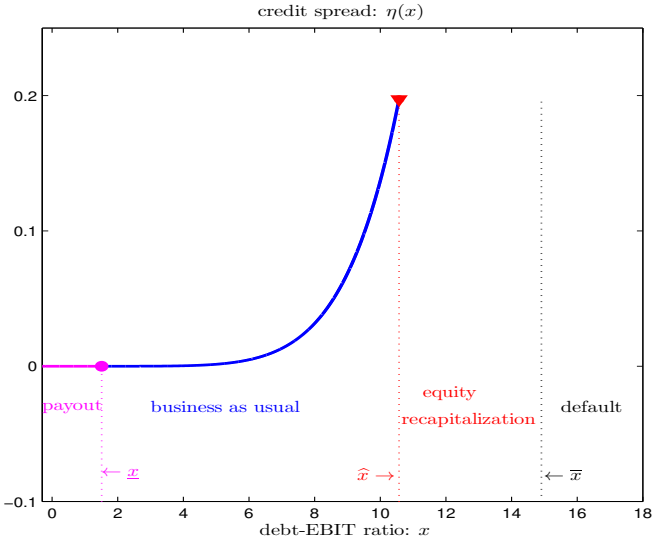


Figure: $\underline{x} = 1.51$, $\widehat{x} = 10.57$, and $\overline{x} = 14.91$ with implied market leverage of $ML(x) = x/v(x)$: $ML(\underline{x}) = 9.34\%$, $ML(\widehat{x}) = 69.67\%$, and 100%, respectively.

Nine Parameters

Equilibrium Credit Spread



Marginal Cost of Debt: $-v'(x)$

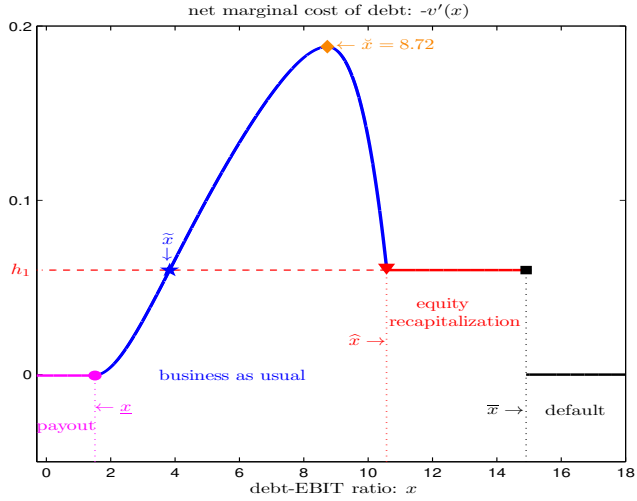


Figure: $v(x)$ is concave for $x \in (\underline{x}, \breve{x}) = (1.51, 8.72)$ and convex for $x \in (\breve{x}, \widehat{x}) = (8.72, 10.57)$. At the inflection point of $v(x)$: $\breve{x} = 8.72$, market leverage is 56.51%. The optimal equity recapitalization target is $\widetilde{x} = 3.83$ where market leverage is 23.76%. In the equity-issuance region where $x \in (\widehat{x}, \overline{x}) = (10.57, 17.17)$, $-v'(x) = h_1 = 0.06$.

Increasing Equity Issuance Costs Lowers Leverage

h_0	Mean	Std. dev.	5%	50%	95%
0.54	**0.199**	0.114	0.096	0.158	0.447
0	**0.282**	0.101	0.154	0.264	0.462
2	0.144	0.106	0.071	0.102	0.373
no issuance option	**0.038**	0.026	0.028	0.031	0.070

- Even small fixed equity issue costs have significant effects
- Without equity issuance option, leverage is close to zero
- Graham and Harvey (2001): "financial flexibility" and "insufficient internal funds" are CFOs' top considerations

Effects of Jump-Diffusion Shocks are Significant

	Mean
baseline	**0.199**
$\beta = 19$	**0.329**
$\lambda = 1$	**0.242**

baseline: $\beta = 6.6$, $\lambda = 2.5$, $\sigma = 40.6\%$

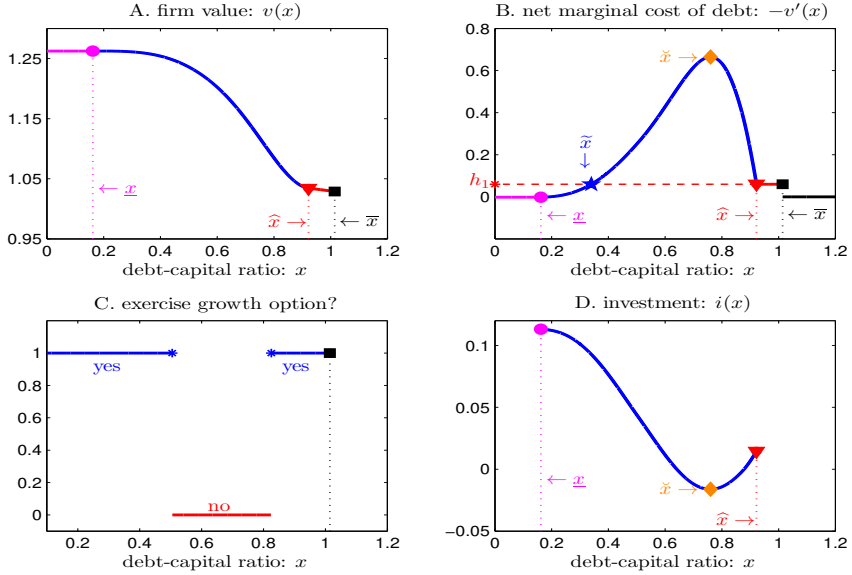
- Graham and Harvey (2001): "earnings and cash flow volatility" is at the top of CFOs' considerations

Tax Effects (τ) are Moderate and Financial Distress Effects (ℓ) are Tiny

	Mean
$\tau = 21\%$, $\ell = 4.2$	**0.199**
$\tau = 10\%$	**0.147**
$\tau = 30\%$	**0.228**
$\ell = 2$	**0.191**
$\ell = 8$	**0.212**

- Graham and Harvey (2001): "interest tax savings" around the middle of and "bankruptcy/distress" costs near the bottom of the CFO considerations

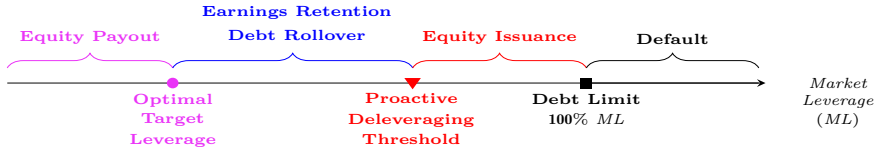
3. Growth Options, Investment, and Leverage



Detail

Summary: Key Force and Mechanism

- Higher equity financing costs paradoxically lead to lower leverage because **financial flexibility** is more valuable.
- The firm is in one of four mutually exclusive regions:



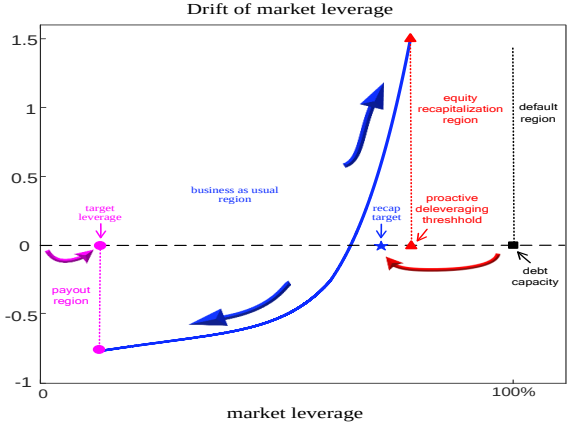
- Four controls drive leverage dynamics:

$$\Delta ML = \text{equity payout} - \text{retained earnings} - \text{equity issuance} + (\mathbf{100\%} - ML)$$

- Ordering of preferred sources of financing: **retained earnings, debt, and external equity.** But in contrast with pecking-order hypothesis, the firm issues equity before exhausting its debt limit to preserve financial slack

Highly Non-linear and Non-monotonic Leverage Dynamics

- credit revolving: reverting to the optimal target or debt spiral
- proactive deleveraging to recapitalization target
- issuing debt to reach the optimal target



Towards an Integrated Dynamic Capital Structure Framework

- *"In short, both the tradeoff model and the pecking order model have serious problems. Thus, it is probably time to stop running empirical horse races between them as stand-alone stories for capital structures. Perhaps it is best to regard the two models as stable mates, with each having elements of truth that help explain some aspects of financing decisions."*

  The last paragraph in Fama and French (2005)

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Thank you!