The Leverage Ratchet Effect

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Motivation

LeLand 94 and subsequent models predict high leverage.

We observe low leverage in real life.

What if we take a dynamic perspective?

LRE predicts higher leverage *ex post*.

Anticipating this, firm chooses lower leverage *ex ante*.

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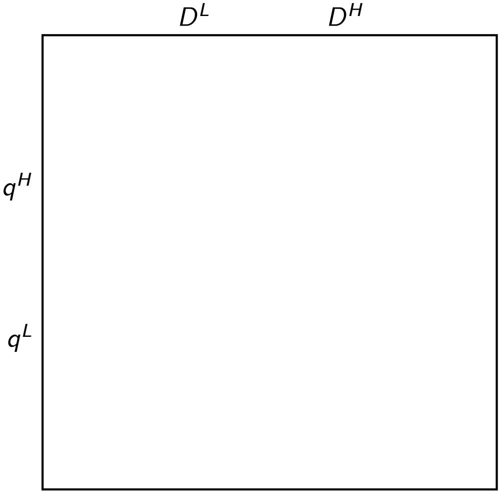
Leverage Ratchet Effect in a Nutshell



Modigliani–Miller

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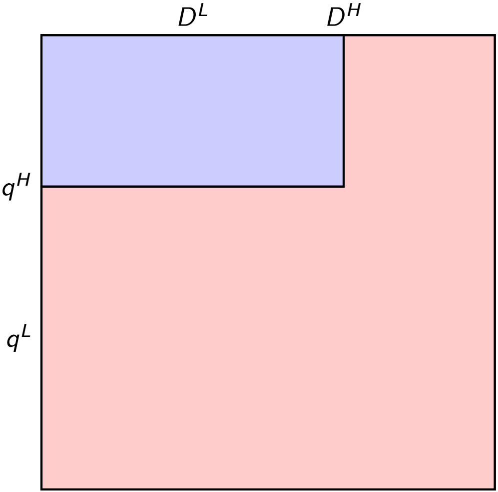

Capital Structure with High Leverage

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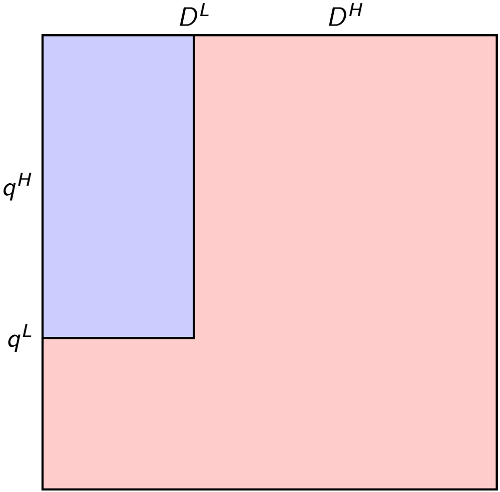

Capital Structure with Low Leverage

Is firm willing to deleverage?

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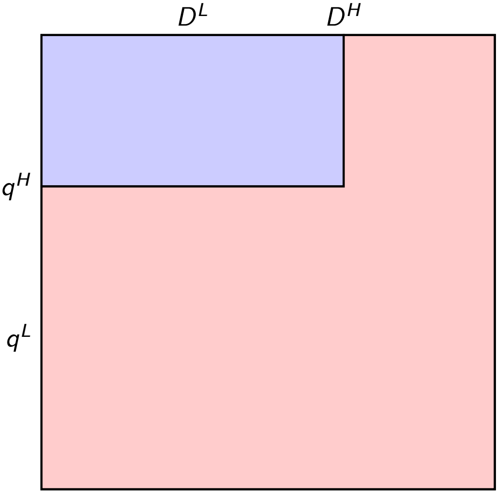

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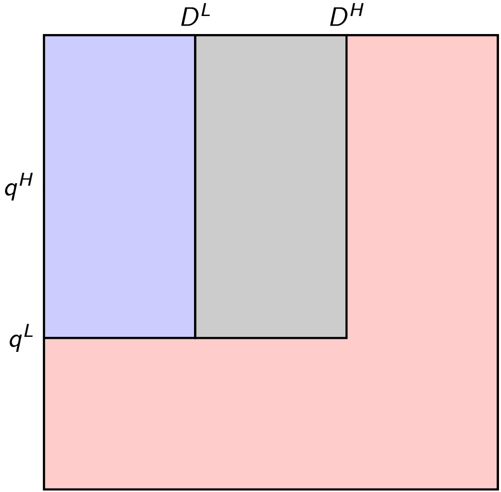

Buy back at q^L

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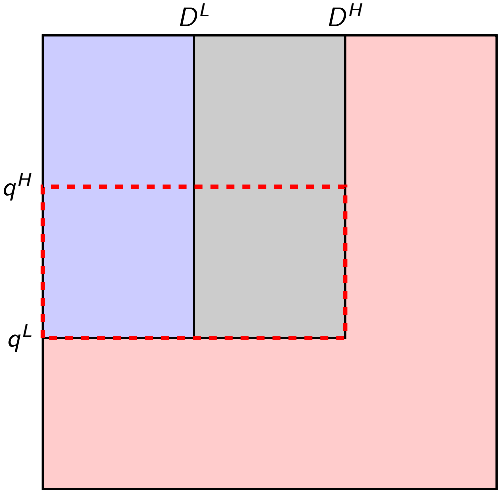

Loss due to deleverage

Is it because q^L too high?

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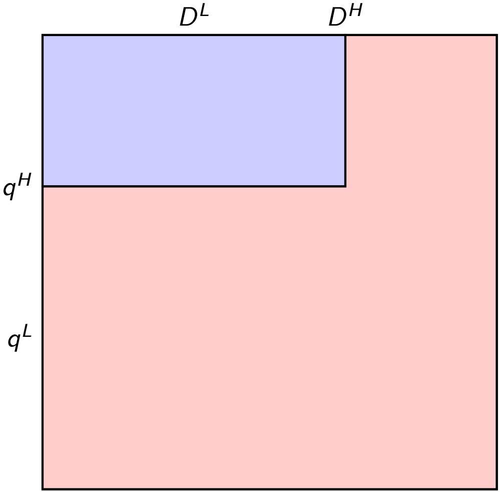

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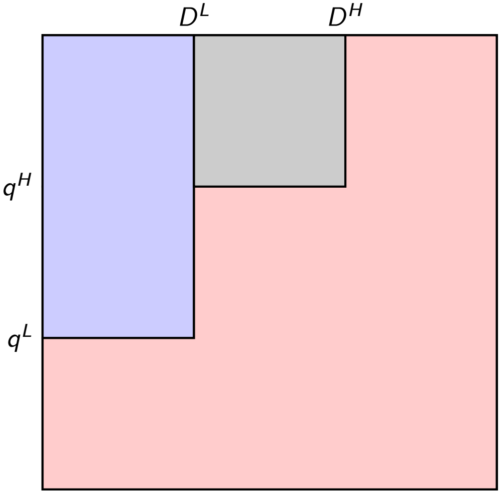

Buy back at q^H

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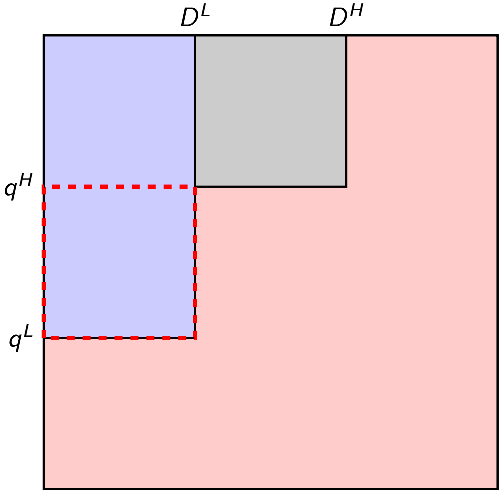

Loss due to deleverage

Firm is not willing to deleverage.

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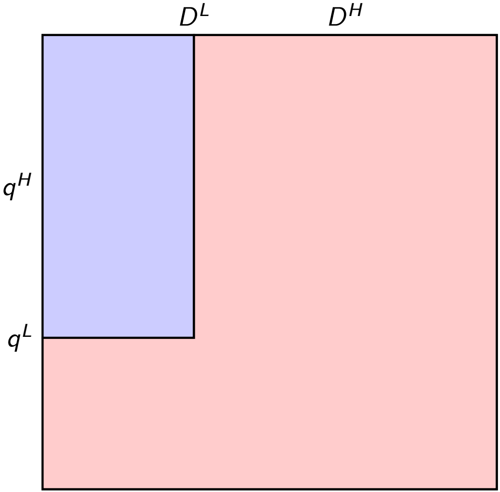

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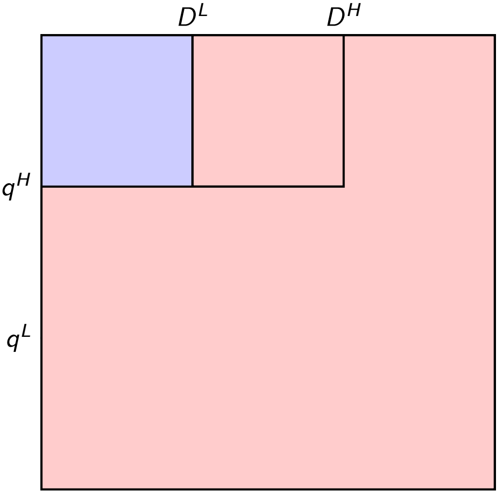
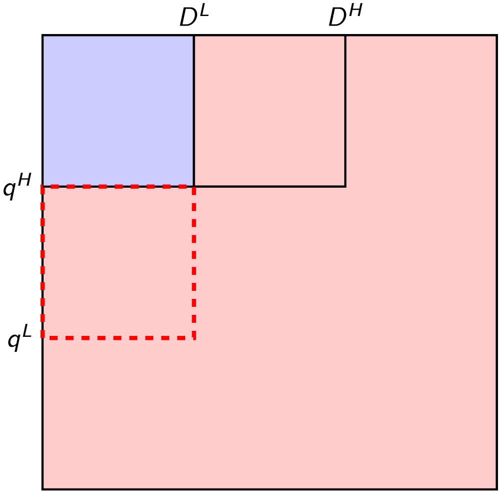


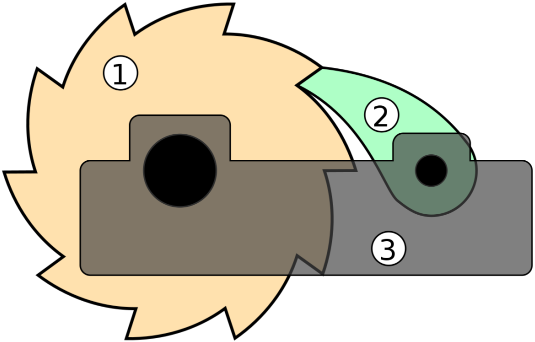
Issue new debt at q^H

Leverage Ratchet Effect in a Nutshell



Gain from increasing leverage

Leverage Ratchet Effect:
It is easy for leverage to go up...
but not the other way around.



Question

So far, with firm value unaffected,

Obs. 1: Firm is not willing to deleverage

Obs. 2: Firm is willing to increase leverage

What if the firm benefits from deleverage?

Benefit 1: Lower leverage mitigates agency conflicts

Benefit 2: Lower leverage reduces bankruptcy cost

What if the firm issues junior debt?

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Setup

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- Corporation is funded with debt D and equity
- Project pays off $X \in \{0, X^L, X^H\}$ with $p = \{1 - p^L - p^H, p^L, p^H\}$
- If $X > D$ the shareholders pay taxes $\tau(X - D)$
- In default bankruptcy costs are $(1 - k)X$

$\mathbf{t = 0}$

- Debt in place $D = D^H$ with value q^H

$\mathbf{t = 1}$

- Stockholders choose new debt level $D \in \{D^L, D^H\}$
- Cost per unit of debt repurchased is q^L

$\mathbf{t = 2}$

- X is realized
- Taxes $t(X - D)$ are paid if $X > D$
- Bankruptcy $(1 - k)X$ costs are paid if $X \in (0, D)$

3 Cases

Baseline Model

- No taxes: $\tau = 0$
- Full recovery: $k = 1$

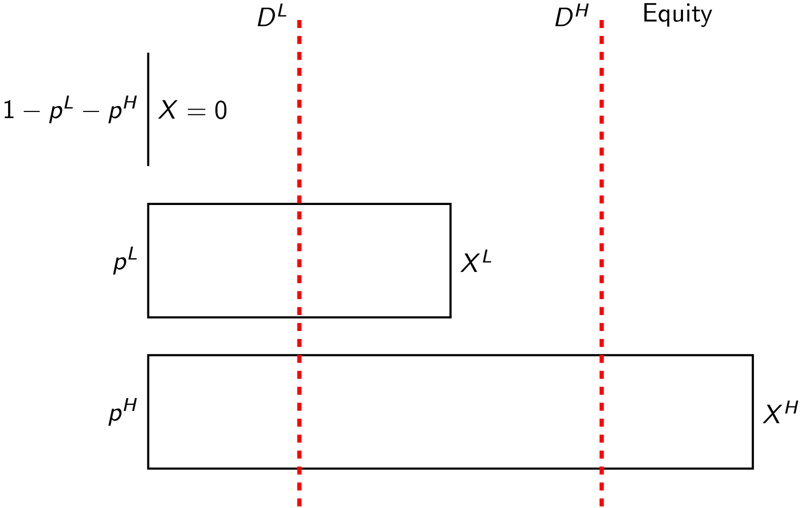
Recovery

- No taxes: $\tau = 0$
- Partial recovery: $0 < k < 1$

Taxation

- Moderate Tax: $0 < \tau < 1$
- Full recovery: $k = 1$

Graphical Representation-Baseline



Baseline Model

Debt Value

$$V^D(D^H) = p^L X^L + p^H D^H$$
$$V^D(D^L) = (p^L + p^H) D^L$$

Price of Debt

$$q^H = \frac{V^D(D^H)}{D^H} = p^L \frac{X^L}{D^H} + p^H$$
$$q^L = \frac{V^D(D^L)}{D^L} = p^L + p^H$$

Equity Value

$$E^H = p^H (X^H - D^H)$$
$$E^L = p^L (X^L - D^L) + p^H (X^H - D^L)$$

Gain from deleverage

$$E^L - E^H - q^L (D^H - D^L) = p^L (X^L - D^H) < 0$$

Mechanism: Loss of Default Option

The loss in equity value is

$$\underbrace{p^L}_{\text{Default Proba.}} \underbrace{(X^L - D^H)}_{\text{Conditional Default Loss}}$$

This is the value of the default option in the state L.

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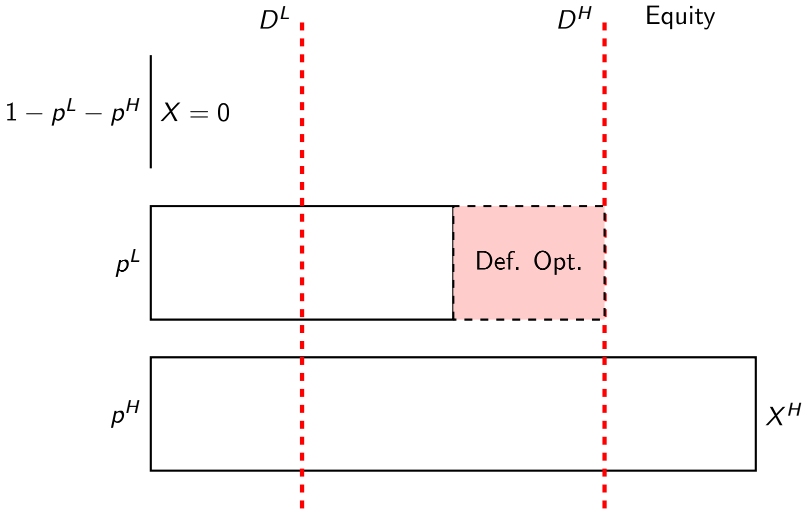
Default Option



Agency Conflicts

Now suppose the equity holder can change the project to Y such that

$$Y = \begin{cases} X^H & \text{with proba. } p^H + \pi \\ 0 & \text{with proba. } 1 - p^H - \pi \end{cases}$$

where $0 < \pi < p^L \frac{X^L - D^L}{X^H - D^L}$.

Note: $\frac{X^L - D^L}{X^H - D^L} < \frac{X^L}{X^H}$

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Agency Conflicts

Firm has incentive to substitute asset when leverage is high

$$(p^H + \pi)(X^H - D^H) > p^H(X^H - D^H)$$

Firm has no incentive to substitute asset when leverage is low

$$(p^H + \pi)(X^H - D^L) < p^H(X^H - D^L) + p^L(X^L - D^L)$$

Firm Value increases from deleverage by

$$\Delta NPV = p^L X^L - \pi X^H > 0$$

Equity Holder's Gain

$$E^L - (p^H + \pi)(X^H - D^H) - q^L(D^H - D^L) = \underbrace{p^L(X^L - D^H)}_{\text{Default Option}} - \underbrace{\pi(X^H - D^H)}_{\text{Agency Rent}} < 0$$

Intuition: Agency conflict is severe when leverage is high;
Reducing leverage reduces agency rent

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Recovery

Now suppose the bankruptcy cost is positive $0 < k < 1$

This change only affects state L.

No default in state H

No recovery in state 0

Partial recovery in state L

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$$V^D(D^L) = (p^L + p^H)D^L$$
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Debt Price

$$q^L = p^L + p^H$$
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Equity Value (not affected)

$$E^L = p^L(X^L - D^L) + p^H(X^H - D^L)$$
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Changes in total firm value

$$\Delta V = E^L + q^L D^L - (E^H + q^H D^H) = (1 - k)p^L X^L > 0$$

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Mechanism

Loss of default option:

$$D^H(q^L - q^H) = p^L(D^H - X^L)$$

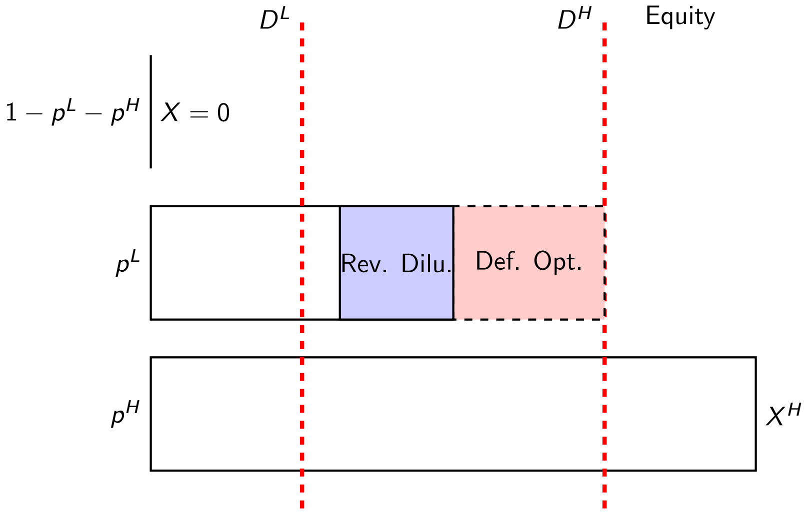
Reverse dilution:

$$p^L(1-k)X^L$$

Gain of the debt holder:

$$(q^L - q^H)D^H = p^L(D^H - kX^L) = \underbrace{p^L(D^H - X^L)}_{\text{default option}} + \underbrace{p^L(1-k)X^L}_{\text{reverse dilution}}$$

Reverse Dilution



Critique

Why doesn't the firm want to deleverage?

The gain $(1-k)X^L$, *no matter how large*, goes to the creditors.

This assumption is hardwired!

Imagine a continuation value W only if the firm doesn't default.

Gains from deleverage is $p^L(X^L - D^H) + p^L W$

Willing to deleverage if $W > D^H - X^L$

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Junior Debt with Taxation

Now we assume a unit tax of $0 < \tau < 1$

Debt repayment D is tax deductible up to X

Existing debt level is D^L and senior

Consider issuance of $D^H - D^L$ junior debt

We consider the case with full recovery, i.e. $k = 1$

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Senior Debt Value

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Senior Debt Price

$$q_S^L = q_S^H = p^L + p^H$$

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Junior Debt Price

$$q_J^H = \frac{V_J^D(D^H)}{D^H - D^L} = p^L \frac{X^L - D^L}{D^H - D^L} + p^H$$

Junior Debt with Taxation

Senior Debt Value

$$V_S^D(D^L) = V_S^D(D^H) = (p^L + p^H)D^L$$

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Junior Debt with Taxation

Equity Value

$$E^L = (1-\tau) \times p^L(X^L - D^L) + (1-\tau) \times p^H(X^H - D^L)$$
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Gain from leverage increase

$$\Delta E = E^H - E^L + q_J^H(D^H - D^L) = \tau(p^L(X^L - D^L) + p^H(D^H - D^L))$$

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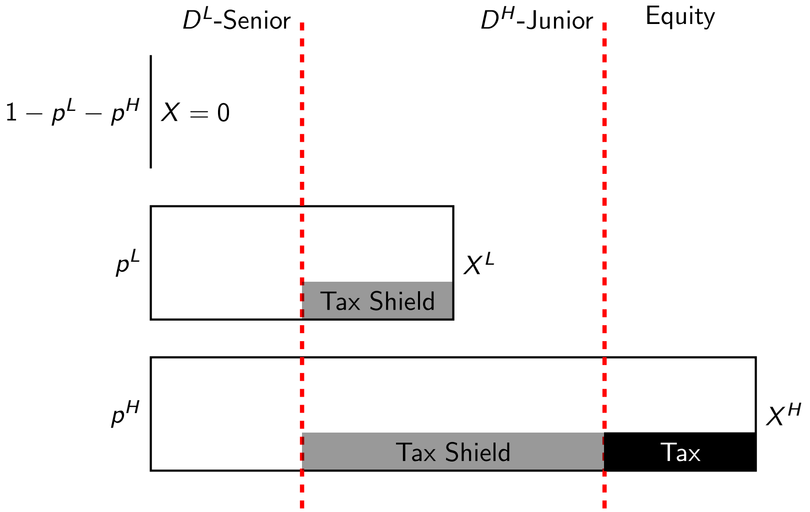
Tax Shield



D^L-Senior
D^H-Junior
Equity
$1 - p^L - p^H$
$X = 0$
p^L
Tax Shield
X^L
p^H
Tax Shield
Tax
X^H

Mechanism

No gains from issuing junior debt if no tax shield $\tau = 0$

Positive gains from issuing even junior debt if $\tau \in (0, 1)$

This is true even if D^L is the ex-ante optimal level in the traditional TOT.

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TOT Firm chooses leverage trading off tax benefits and distress costs

LRE Depends on initial level of debt:

$D_0 = 0$ Efficient debt level is chosen: $D^{LRE} = D^{TOT}$

$D_0 > 0$ Debt ratchets upward: $D^{LRE} > D^{TOT}$

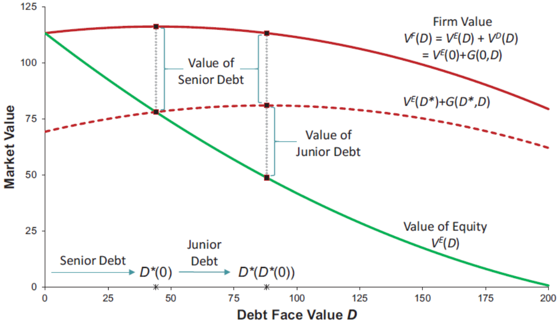

Figure 2: The leverage ratchet effect

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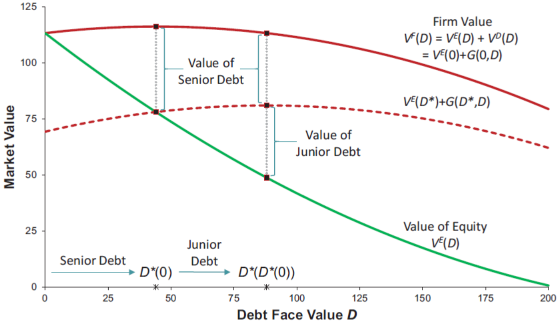

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Corporate Finance Theories

Pecking Order Theory (Myers and Majluf, 1984):

POT Informational frictions imply order of funding

1. Internal funds
2. Risk-free debt
3. Risky debt
4. Hybrid securities
5. Equity

LRE Also applies to rights offerings, retained earnings, ...

Debt Overhang Problem (Myers, 1977):

DOP Too much debt can lead to underinvestment if

$NPV < \overline{NPV}$ Investment not taken due to debt overhand

$NPV \geq \overline{NPV}$ Efficient investment choice restored

LRE Leverage ratchet effect is pervasive for any level of NPV

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Model Predictions

Covenants

- If covenants restrict leverage
  - Should immediately/eventually bind
  - Ideally chosen at $D = D^*$
- If covenants do not restrict leverage
  - *Low* initial leverage
  - *Quickly* increasing leverage over time

Reaction to tax rate changes

- Higher leverage after increase in tax shields
- No such change for decrease in tax shields
- Documented by Heider and Ljungqvist (2015)

Loans vs. Bonds

- Loans are easier to renegotiate than bonds
- Splitting surplus to alleviate LRE easier

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Resistance to reduce leverage
Corporations are unwilling to reduce leverage through the issuance of equity even on the verge on bankruptcy (figure from DeMarzo and He, 2016).

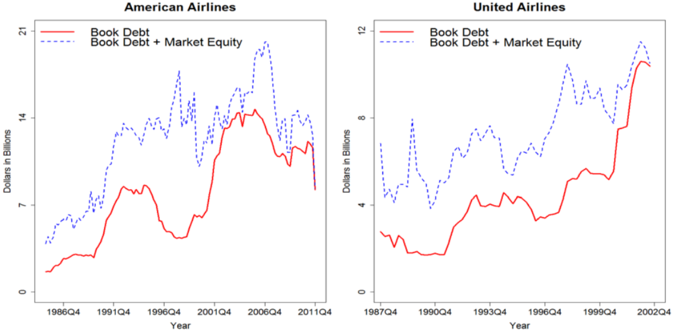

Figure 1: Time-series of outstanding book debt and enterprise value for AA and UA

Empirical Evidence

Equity issuance and capital structure

Firms do not issue equity to change their capital structure but rather increase leverage following equity issuances (table from Welch, 2011).

	Constants	$SSTK/BCP_{-1}$	$\bar{R}^2$ (%)
BV			
Δ(FD/BCP)			
Coef	0.265	14.814	
Std coef	0.000	0.035	
T_{NW}	(+0.70)	(+1.43)	(+0.1)
Δ(LT/AT)			
Coef	0.447	2.484	
Std coef	0.000	0.015	
T_{NW}	(+3.09)	(+0.39)	(−0.0)
MV			
Δ(FD/MCP)			
Coef	1.874	27.383	
Std coef	0.000	0.114	
T_{NW}	(+8.01)	(+2.22)	(+1.3)
Δ(LT/MAT)			
Coef	2.148	12.905	
Std coef	0.000	0.056	
T_{NW}	(+10.61)	(+1.41)	(+0.3)

Table 2: Changes in leverage and issuing activity

Empirical Evidence

Bank regulation
Admati et al. (2013) argue that high bank leverage could be a result of the LRE. Reducing bank leverage could decrease inefficiencies. Recall that Basel III mandates a leverage ratio of 3%. Consistent with LRE, even when forced to reduce leverage banks do not issue equity to do so (figure from Gropp et al., 2019).

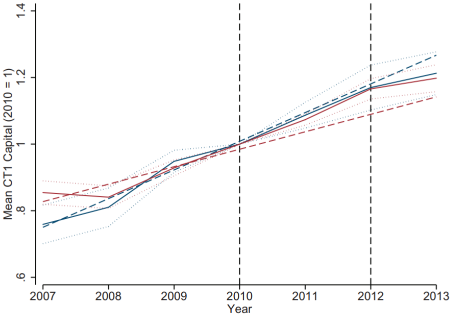

Figure 2: Core tier 1 capital over time - Full Sample

Empirical Evidence

Shadow banks
From call report data it seems like the distribution of capital ratios of shadow banks is much wider than for banks. Since shadow banks are less regulated, this would be consistent with history-dependent leverage, as implied by the LRE (figure from Jiang et al., 2020).

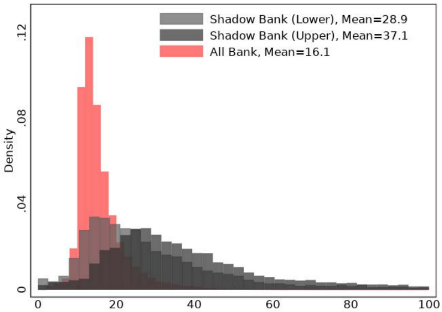

Figure 3: Tier 1 Capital Ratio – Shadow Banks vs All Banks

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