Dynamic Capital Structure under Managerial Entrenchment: Evidence from a Structural Estimation

E. Morellec, B. Nikolov, and N. Schürhoff
University of Lausanne and Swiss Finance Institute

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Motivation
Can capital structure be best explained by market frictions and/or agency conflicts?

- Capital structure determined by broad range of factors, including tangible market frictions & agency conflicts

- **Trade-off theory**: Main quantitative theory subjected to data
  1. **Tax shields vs. Bankruptcy costs**: Predicts target leverage $\gg 50$
  2. **Refinancing/Issuance costs**: Target leverage vs. leverage distribution

- **Agency theory**: Mostly directional predictions regarding
  1. manager-shareholder conflicts [Jensen (86), Zwiebel (96)]
  2. shareholder-bondholder conflicts [Fan & Sundaresan (00)]

  Other theories: Asymmetric info (Pecking order) & Behavioral (Market timing)

$\Rightarrow$ Magnitude of conflicts of interests within the firm and their quantitative effect on financing decisions still open questions!
The capital structure puzzle

Empirical leverage distribution (Compustat)

Leverage (narrow)

Leverage (broad)
Capital structure stylized empirical facts
Empirical literature has uncovered several patterns that seem inconsistent with theory

Fact 1: **Firms use debt financing too conservatively** [Graham (JF, 2000), Strebulaev & Yang (2007)]

Fact 2: **Negative relation between profitability and leverage** [Myers (JACF, 1993), Myers & Shyam-Sunder (JFE, 1999)]

Fact 3: **Firms mean-revert slowly towards target leverage** [Fama & French (RFS, 2002), Flannery & Rangan (JFE, 2006)]

Fact 4: **Changes in market leverage are largely explained by changes in equity prices** [Welch (JPE, 2004)]

Fact 5: **Leverage largely driven by unexplained firm-specific fixed effect** [Lemmon, Roberts, Zender (JF, 2006)]

Fact 6: **Link between governance mechanisms & leverage ambiguous** [Berger, Ofek & Yermack (JF, 1997), John & Litov (2008)]
Dynamic trade-off theory

- Important role of **refinancing costs** [Fischer, Heinkel, Zechner (JF, 1989), Goldstein, Ju, Leland (JB, 2001)]

- Wedge between **target leverage** vs observed **leverage distribution**
  - When it is costly to refinance, firms are not always at the target & variation around the target is observed
  - Predictions **qualitatively** consistent with evidence [Strebulaev (07)]:
    
    *The greater the external financing costs,*
    
    1. **the lower the firm’s target leverage** (Fact 1)
    2. **the greater the inertia in financing choices** (Facts 2-4)

- Quantitatively, **issuance costs would have to be** $\sim 25\%$ on average to justify observed financing decisions
  (Source: structural estimates from GJL model on Compustat firms)
Histogram of estimated refinancing costs

- Quantitatively, one needs **large issuance costs**: 25% on average to justify observed financing decisions
  (Source: structural estimates from GJL model on Compustat firms)
Comparative Statics: Refinancing cost $\lambda$

Effect of refinancing cost on target leverage & refinancing threshold

- $\lambda \uparrow \Rightarrow$ Refinance less frequently but issue a lot b/c tax shields
  $\Rightarrow$ Refinancing threshold down but target leverage still high
Dynamic trade-off theory that accounts for separation of ownership and control can explain stylized facts 1-6

Model: Firm’s capital structure determined by dynamic trade-off between

1. real market frictions (taxes, bankruptcy costs, refinancing costs)
2. degree of managerial entrenchment, due to cost of control challenges

Question: How large do manager-shareholder conflicts of interest have to be in order to explain firms’ capital structure dynamics?

Structural estimation:

1. infer degree of managerial entrenchment & shareholders’ bargaining position from observed financing choices
2. provide new evidence on how governance mechanisms affect capital structure dynamics
Main Results

1. Classic trade-off theory performs poorly
   - Refinancing costs $\approx 15-60\%$ of debt to explain Facts 1-5

2. **Dynamic trade-off theory augmented by agency conflicts** matches both time-series & cross-sectional patterns (Facts 1-6)
   (a) Little leverage on average (**Fact 1**)  
   (b) Capital structure persistent & slowly mean-reverting (**Facts 2-4**)  
   (c) Sizeable cross-sectional variation in cost of control challenges (**Fact 5**)
       - Structural interpretation for unexplained firm fixed effects in LRZ

3. Estimated agency conflicts are moderate & in line with other studies  
   - Managerial entrenchment of 2-5\% on average (0.8-5\% at median)  
   - Shareholders’ bargaining power of 50-60\% on average

4. Governance mechanisms significantly & consistently affect degree of managerial entrenchment (**Fact 6**)
Model Assumptions

- **Firms:**
  - Large # of heterogeneous firms characterized by parameters $\theta_i$
  - Firm $i$ has assets in place that generate operating cash flows $X_i \sim \text{GBM}$
    \[
    dX_{it} = \mu_i X_{it} dt + \sigma_i X_{it} dZ_{it}, \quad X_{i0} = x_i > 0,
    \]

- **Taxes:** Firms face corporate tax rate $\tau^c$, investors are subject to personal tax rate on dividends $\tau^d$ and coupons $\tau^i$ (double taxation)

- **Capital structure:** (see FHZ, GJL)
  - Risky long-term debt that is callable [vs. Hennessy & Whited (2005)]
  - Proceeds from debt issuance are paid as cash distribution to shareholders on a *pro rata* basis (enforceable)
  - Refinancing costs: $\lambda\%$ proportional flotation costs of debt issue ($\sim 1\%$)
Model Assumptions: Shareholders-bondholders conflicts

- Default decision is endogenous & subject to conflict of interest [Fan and Sundaresan (2000)]
- Default is costly: $\alpha\%$ (liquidation) $>$ $\kappa\%$ (renegotiation)
  $\Rightarrow$ Deviations from APR in default
  $\Rightarrow$ Shareholders default sooner & debt is more costly
- Nash bargaining in default yields simple sharing rule:
  - $\eta \times Surplus$ for shareholders
  - $(1 - \eta) \times Surplus$ for bondholders
- One of our objectives is to estimate shareholders’ bargaining power $\eta_i$
  - Prediction: $\eta$ large $\Rightarrow$
    1. shareholders default sooner (high leverage unlikely)
    2. debt is more costly (lower target leverage)
Model Assumptions: Managers-shareholders conflicts

- Managers act in their own interests and have discretion over payout & financing policy [managerial-optimal approach of Zwiebel (1996)]

- Managers’ incentives (partially) aligned with shareholders through
  1. ownership share \(\phi\%
  2. threat of control challenges

- Costliness of control challenges, \(\phi\delta F^*(x)\), creates space for **managerial rents** (hidden compensation)
  - Management’s stake exceeds direct ownership \(\phi\) by entrenchment \(\psi(x)\):

\[
M(x) = \phi V^*(x) + \psi(x) (1 - \phi) F^*(x)
\]

  - \(\phi > 0\): efficient choice of debt (optimal for shareholders) differs from entrenchment choice (optimal for managers)
    - Debt limits managerial rents \((F^*(x)\) decreases with selected debt level), but benefits from restructuring accrue mostly to shareholders!
Endogenously determined:

1. **Manager’s rents**: \( \phi(1 - \tau^c)(X_t - c_t) \) (i.e., \( \psi(x) = \phi \forall x \))

2. **Firm’s payout policy**: \( (1 - \phi)(1 - \tau^c)(X_t - c_t) \)

3. **Firm’s financing policy (target leverage, refinancing & default)**:
   
   (a) Firms adjust capital structure upwards when \( X \geq U(c_t, \eta, \phi) \) & downwards in default when \( X \leq B(c_t, \eta, \phi) \) [GJL, FHZ, Gilson (1997)]
   
   (b) Target leverage: \( \frac{c^*}{X} = \rho(\eta, \phi) \)
Comparative Statics: Time-series distribution of leverage

**Bargaining power of shareholders**

- $\eta = 80\%$
- $\eta = 40\%$

**Cost of control challenges**

- $\phi = 1\%$
- $\phi = 0.5\%$

- **Prediction:** $\eta$ large $\Rightarrow$
  1. shareholders default sooner (high leverage unlikely)
  2. debt more costly (lower target leverage)

- **Prediction:** $\phi$ large $\Rightarrow$
  1. managers refinance less frequently (low leverage likely)
  2. refinancing cheap, yet debt has private cost (lower target leverage)
Estimation

Use predicted leverage dist. from model to back out firm-specific $\phi_i$ and $\eta_i$ from real data

- Allow for observed & unobserved heterogeneity in parameters $\theta_i$:

![Graph showing leverage distribution for four firms](image)

- Empirical specification of the key parameters $(\phi_i, \eta_i) \in [0, 1]$:

  $$\phi_i = \Phi(\alpha_\phi + \epsilon_i^\phi), \text{ and } \eta_i = \Phi(\alpha_\eta + \epsilon_i^\eta),$$

  where

  $$\left(\begin{array}{c}
  \epsilon_i^\phi \\
  \epsilon_i^\eta
  \end{array}\right) \sim \mathcal{N}(0, \begin{bmatrix}
  \sigma^2_\phi & \sigma_{\phi\eta} \\
  \sigma_{\phi\eta} & \sigma^2_\eta
  \end{bmatrix}).$$
Estimation

- Integrating out the random effects from the joint likelihood
  \( f(y_i, \epsilon_i; \theta, x_i) = f(y_i|\epsilon_i; \theta, x_i)f(\epsilon_i|\theta) \), we obtain the log-marginal likelihood function as

  \[
  \ln \mathcal{L}(\theta; y, x) = \sum_{i=1}^{N} \ln \int_{\epsilon_i} \left( f(y_{i1}|\epsilon_i; \theta, x_i) \prod_{t=2}^{n_i} f(y_{it}|y_{it-1}, \epsilon_i; \theta, x_i) \right) f(\epsilon_i|\theta) d\epsilon_i
  \]

- **Key:** Explicit expressions for stationary density \( f(y_{i1}|\epsilon_i; \theta, x_i) \) and conditional density \( f(y_{it}|y_{it-1}, \epsilon_i; \theta, x_i) \) are derived in the paper.
Data: Panel of Compustat firms

- Financials: **Compustat, I/B/E/S**
- Stock prices: **CRSP**
- External and internal governance mechanisms:
  - ExecuComp: managerial characteristics & inside ownership
  - IRRC: blockholders, directors characteristics & anti-takeover provisions
  - Thomson Financials: institutional ownership
- Economy indicators: **FRB**

The intersection of all databases yields a panel data set with **13,159** observations for **809** firms, for the time period between 1992 and 2004 at quarterly frequency.
Parameters

Parametrization is standard

- **Long-term growth rate** $m_{it} = \alpha_m + \beta_m \hat{m}_{it}$, where $\hat{m}_{it} = I/B/E/S$ consensus forecast (or 5yr growth rate of OIBD from Compustat)

- **Cash flow volatility** $\sigma_{it} = \sigma_{it}^{E} \frac{\partial E_t}{\partial X_t} \frac{X_t}{E_t}$, where $\sigma_{it}^{E}$ is the standard deviation of monthly equity returns over the past five years.

- **Risk-adjusted discount rate** $\mu_{it} = m_{it} - \hat{\beta}_{it} \hat{\kappa}_t$ with market betas $\hat{\beta}_{it}$ estimated from monthly equity returns (60 month rolling-window)

- **Liquidation cost** $\alpha_{it} = 1 - (\text{Tangibility}_{it} + \text{Cash}_{it}) / \text{Total Assets}_{it}$ [Berger, Ofek, and Swary (1996)]

- **Managerial incentive alignment** $\varphi = \varphi^{E}$ top-5 exec shares or managerial incentives $\varphi = \varphi^{E} + \delta_{\text{shares by options awards}} / \text{shares outstanding}$ [Jensen and Murphy (1990); $\delta_{\text{shares by options awards}}$: Core and Guay (1999)]

- Remaining parameters standard: $(r = 4.21\%, \kappa = 6\%, \tau^c = 35\%, \tau^d = 11.6\%, \tau^i = 29.3\%, \kappa = 0\%/15\%, \lambda = .5\%)$
Results: Parameter Estimates

- Model **without agency conflicts** is nested in ours \((\phi_i = \eta_i = 0)\)
- Structural estimates for the model **with agency conflicts**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coef.</th>
<th>t-Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\alpha_\phi)</td>
<td>-2.65</td>
<td>(-148.48)</td>
</tr>
<tr>
<td>(\alpha_\eta)</td>
<td>-0.08</td>
<td>(-0.41)</td>
</tr>
<tr>
<td>(\sigma_\phi)</td>
<td>1.26</td>
<td>(44.41)</td>
</tr>
<tr>
<td>(\sigma_\eta)</td>
<td>2.86</td>
<td>(3.82)</td>
</tr>
<tr>
<td>(\sigma_{\phi\eta})</td>
<td>-1.24</td>
<td>(-4.71)</td>
</tr>
</tbody>
</table>

Auxiliary Parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coef.</th>
<th>t-Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\alpha_\sigma)</td>
<td>0.01</td>
<td>(0.19)</td>
</tr>
<tr>
<td>(\beta_\sigma)</td>
<td>0.72</td>
<td>(6.59)</td>
</tr>
<tr>
<td>(\alpha_m)</td>
<td>0.34</td>
<td>(1.06)</td>
</tr>
<tr>
<td>(\beta_m)</td>
<td>0.00</td>
<td>(0.00)</td>
</tr>
</tbody>
</table>

Log-likelihood: 8,938
Observations: 13,159
Managerial Entrenchment and Bargaining Power

Predicted values given data \((y_{it}, x_{it})\): \(E[\phi_i|y_{it}, x_{it}; \theta]\) and \(E[\eta_i|y_{it}, x_{it}; \theta]\)

- Managerial entrenchment: Mean = 5%, median = 2.6%
- Shareholders’ bargaining power in default: Mean/median = 55%
- Sizeable cross-sectional variation in \(\phi_i\) and \(\eta_i\)

Managerial entrenchment %

Bargaining power of shareholders %

- Robust to \(\lambda, \kappa, \varphi^E\), alternative leverage def., etc.
Facts 5-6: Determinants of the Cost of Control Challenges

How effective are various governance mechanisms at reducing agency costs?

- Entrenchment positively related to CEO tenure, ROA, M/B, -Size, R&D, Yield Curve, Credit Spread

- Governance mechanisms inversely related to entrenchment (Fact 6) [Bebchuk, Cohen and Farell (2004)]

- Large portion of firm-fixed effect explained by governance variables ($R^2 = 47\%$, Fact 5)

<table>
<thead>
<tr>
<th>Specification</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional Ownership</td>
<td>-273.33***</td>
<td>-113.80***</td>
<td>-62.09*</td>
</tr>
<tr>
<td>Blockholder Ownership</td>
<td>-109.30**</td>
<td>-159.54***</td>
<td>-144.36**</td>
</tr>
<tr>
<td>BCF Index - Dictatorship</td>
<td>563.97***</td>
<td>621.92***</td>
<td>537.79***</td>
</tr>
<tr>
<td>Board Independence</td>
<td></td>
<td>-236.06***</td>
<td></td>
</tr>
<tr>
<td>Board Committees</td>
<td></td>
<td></td>
<td>-36.27***</td>
</tr>
<tr>
<td>CEO Tenure</td>
<td>10.70***</td>
<td>9.66***</td>
<td>9.72***</td>
</tr>
<tr>
<td></td>
<td>$R^2$</td>
<td>0.47</td>
<td>0.47</td>
</tr>
</tbody>
</table>
We estimate the following model:

\[ L_{t+k} = \alpha_0 + \alpha_1 L_t + \alpha_2 IDR_{t,t+k} + \epsilon_t \]

where IDR is the **implied debt ratio**.

- \( \alpha_1 = 1 \): Firms fully offset \( \Delta \)stock price by issuing debt or equity
- \( \alpha_2 = 1 \): Firms do not readjust capital structure following \( \Delta \)stock price

<table>
<thead>
<tr>
<th>Lag k in years</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Simulated data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( IDR_{t-k,t} )</td>
<td>1.06</td>
<td>0.93</td>
<td>0.84</td>
<td>0.68</td>
</tr>
<tr>
<td>5%</td>
<td>1.05</td>
<td>0.92</td>
<td>0.82</td>
<td>0.66</td>
</tr>
<tr>
<td>95%</td>
<td>1.07</td>
<td>0.95</td>
<td>0.86</td>
<td>0.70</td>
</tr>
<tr>
<td><strong>Panel B: Empirical literature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welch</td>
<td>1.01</td>
<td>0.94</td>
<td>0.87</td>
<td>0.71</td>
</tr>
<tr>
<td>Strebulaev</td>
<td>1.03</td>
<td>0.89</td>
<td>0.79</td>
<td>0.59</td>
</tr>
</tbody>
</table>

- Perform Fama-MacBeth regression of partial-adjustment model:

\[ L_{t+1} - L_t = \alpha + \lambda_1 TL_t + \lambda_2 L_t + \epsilon_t \]

where \( L \) is Leverage and \( TL \) is firm’s Target Leverage from 1\(^{st} \) stage.

- PAM predicts \( \lambda_1 = -\lambda_2 \) and \( \lambda_1 \) measures speed of adjustment
- \( \lambda_1 = 1 \): Firms instantly readjust leverage to the target
- \( \lambda_2 = -1 \): Firms are completely inactive.

- Fama and French (2002) find coefficients of 0.07 for dividend payers:

\[
\begin{array}{c|c}
\hline
& (1) \\
\hline
TL_{t-1} & 0.06 \\
\text{(71.20)} & \\
L_{t-1} & -0.06 \\
\text{(94.90)} & \\
\hline
\end{array}
\]
Conclusion

- Structural estimation of a dynamic capital structure model augmented by agency conflicts
- Moderate values for the cost of control challenge and bargaining power of shareholders can solve the low-leverage and zero-leverage puzzles while matching the time-series properties of capital structure
- Internal & external governance mechanisms significantly affect managerial entrenchment