

# **How Stable Are Corporate Capital Structures?**

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# Key questions:

- How stable is corporate leverage over extended time horizons?
- What does the evidence on leverage stability imply about credible theories of capital structure?

## **What the literature says about leverage stability:**

- Lemmon, Roberts, and Zender (2008):  
“Leverage ratios are remarkably stable over time; firms with relatively high (low) leverage tend to maintain relatively high (low) leverage for over 20 years.”
- Frank and Goyal (2008):  
“A satisfactory theory must explain why firms keep leverage stationary.”

## **What the literature says, cont.:**

- Lemmon, Roberts, and Zender (2008):  
“Theories of capital structure based on volatile factors, in a time-series sense, are unlikely explanations for capital structure heterogeneity.”
- Rauh and Sufi (2011):  
“The extant research strongly argues that cross-sectional variation in capital structure is where researchers should focus.”

## **Is the capital structure puzzle mainly about explaining a largely stable leverage cross section?**

- Should researchers focus mainly on explaining why different firms have different leverage ratios at a given point in time?
- Should researchers focus on explaining why a given firm's leverage changes over time?
- Are these two issues separable?
- Or does a full explanation of cross-firm variation requires an explanation of leverage variation over time?

## **Main empirical findings for CRSP/Compustat industrial firms:**

- Leverage cross sections more than a few years apart differ markedly.
- The differences between cross sections grow over time rather than revert or stabilize.
- Migration of firms over the leverage cross section is a pervasive phenomenon.
- Many firms have high and low leverage at different times, but few firms keep Debt/TA always above 0.500.

## **Main empirical findings, cont.**

- Capital-structure stability for individual firms is the exception, not the rule.
- When stable leverage regimes do arise, they are almost always temporary and they occur mainly at low leverage.
- Many firms abandoned low leverage during the post-war boom.
- Industry-median leverage ratios (at the 2-, 3-, and 4-digit SIC levels) vary widely over time.

## **Main empirical findings, cont.**

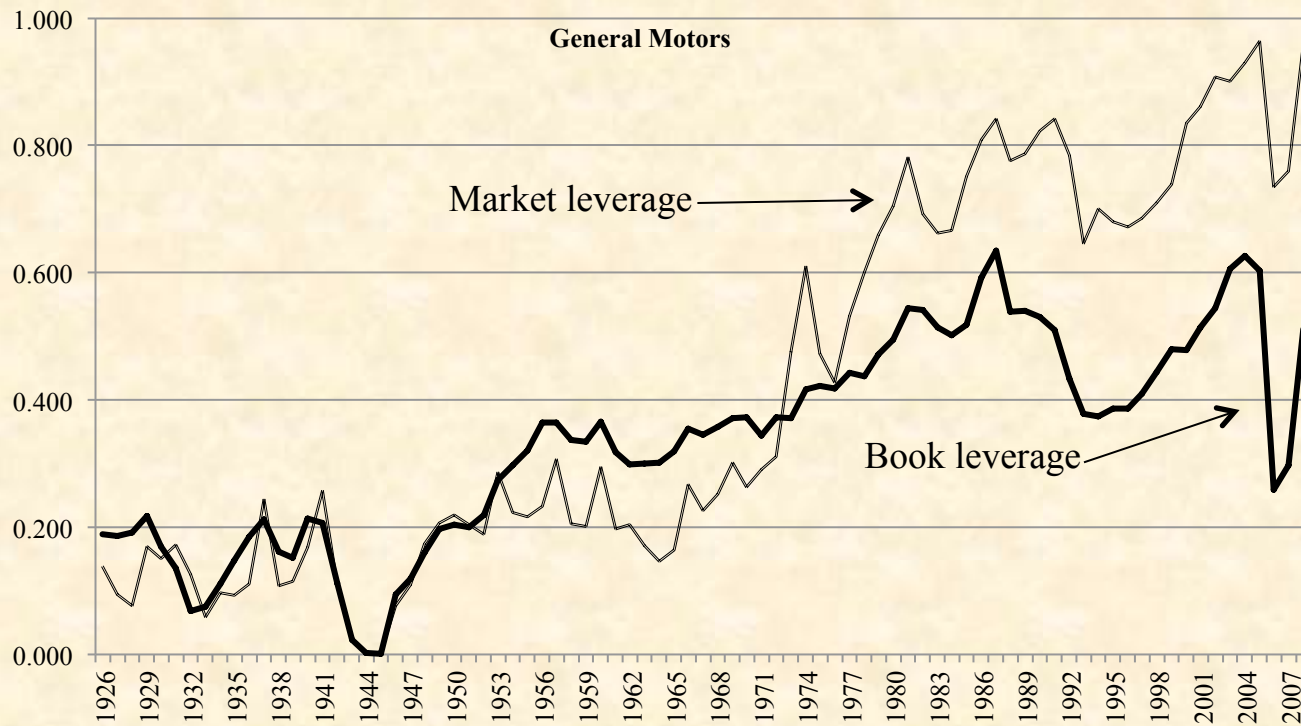
- Targeting models that allow wide leverage variation do a good job replicating the substantial instability of the cross section.
- Models with time-varying target ratios that vary a lot do the best job.
- Two other models that also do a good job:
  - target zones with flexible boundaries.
  - speeds of adjustment of about 15% per year to stationary target ratios.



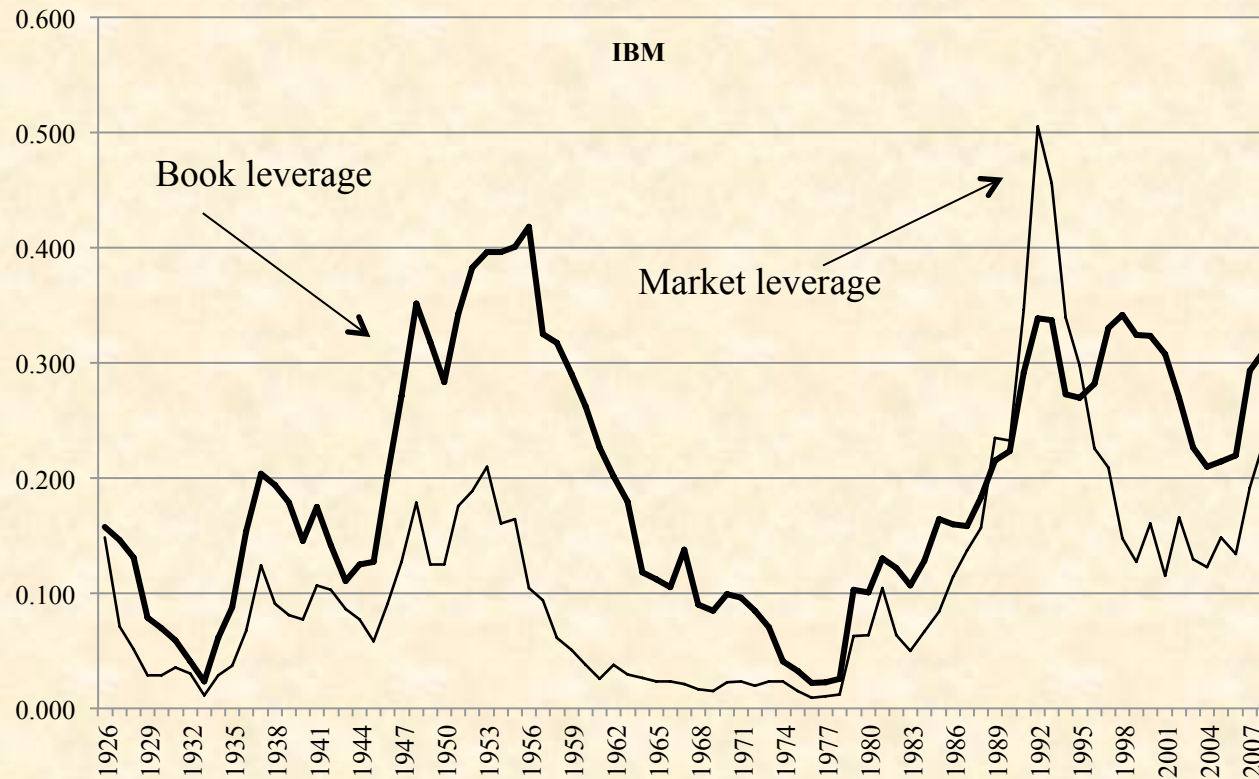
## **Main empirical findings, cont.**

- Random-financing (neutral-mutation) models do a terrible job replicating the instability of the leverage cross section.
- A poor job replicating the instability of the cross section is also done by models with:
  - target zones with relatively inflexible boundaries.
  - speeds of adjustment of 30% or higher per year to stationary target ratios.

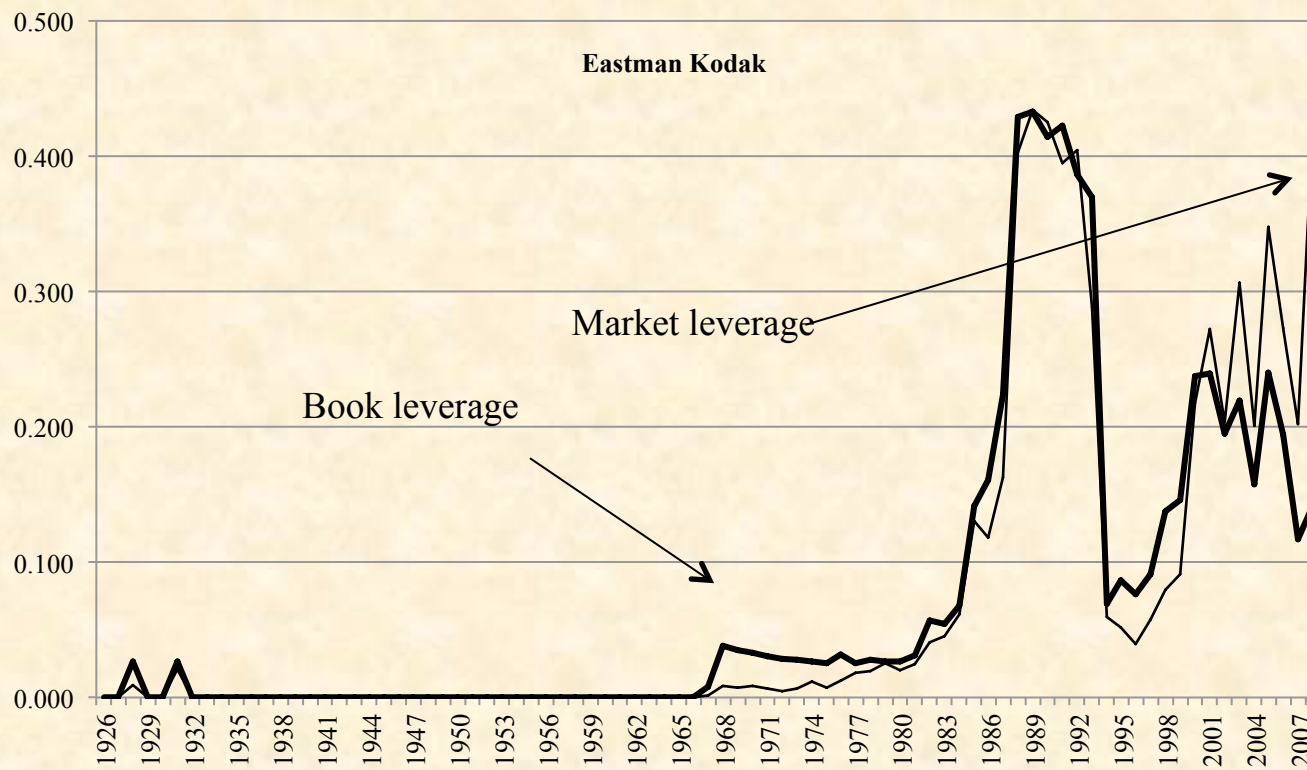
# Some examples of time-series variation in leverage: General Motors' leverage, 1926 to 2008



# IBM's leverage, 1926 to 2008



# Eastman Kodak's leverage, 1926 to 2008



## **Appendix A has leverage plots dating back to before the Great Depression for 21 other DJIA firms**

- As with GM, IBM, and Kodak, these plots show substantial leverage instability:
  - Virtually all of these DJIA firms have had low and high leverage at different times.
  - Dramatic leverage spikes arise often, and long and substantial leverage drifts are commonplace.
- These examples indicate there is much yet to be learned about whether, or in what sense, capital structures are aptly described as stable.

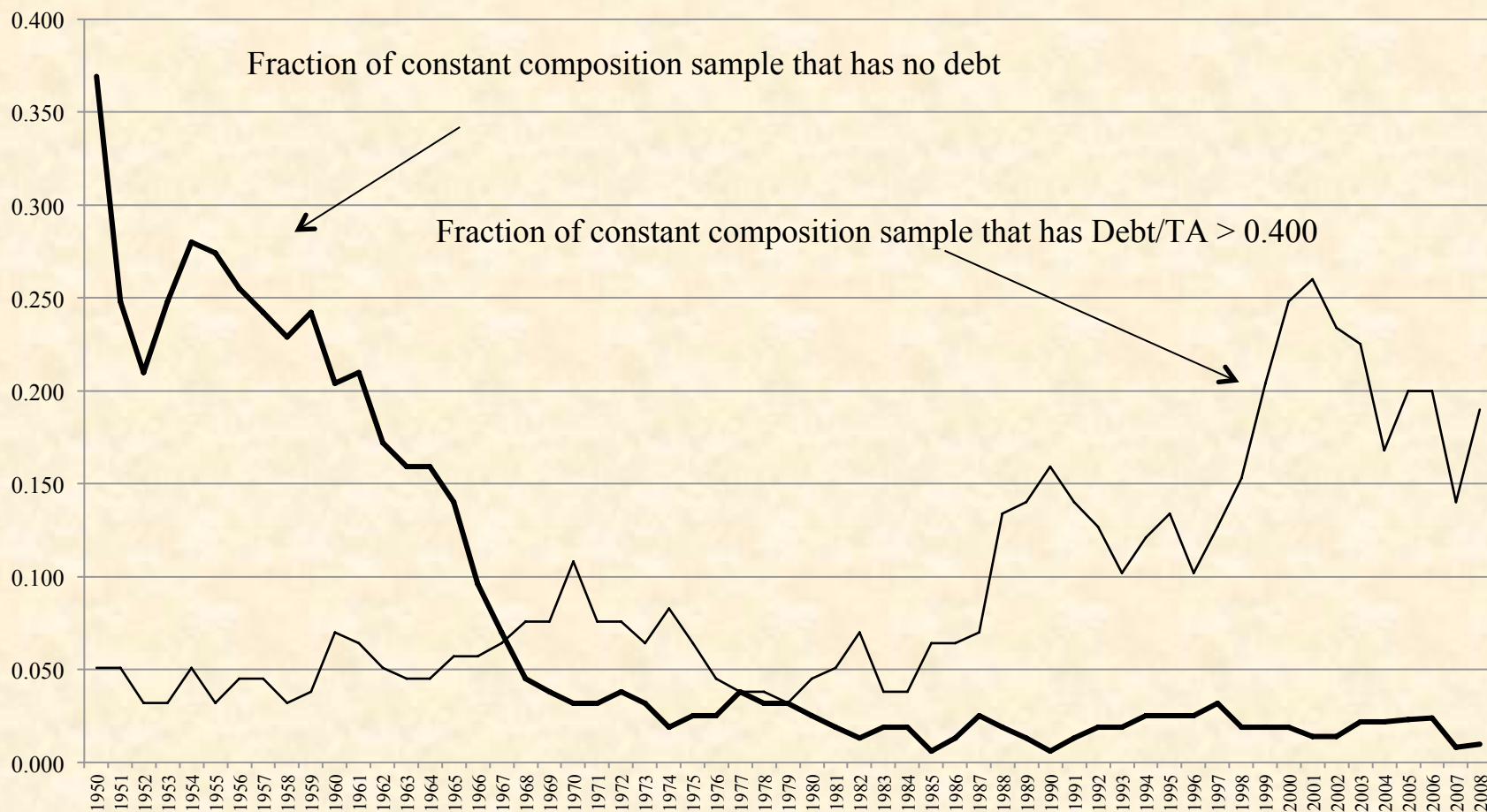
# Time-series range and standard deviation of leverage: Compustat industrial firms listed 20+ years

	Median firm's range	Median firm's standard deviation
Book leverage Debt/Total Assets	0.391	0.106
Market leverage Debt/[Debt + MV Equity]	0.536	0.144
Net-Debt ratio [Debt – Cash]/Total Assets	0.599	0.153

## **Other basic facts about time-series variation in leverage at industrial firms:**

- Extended periods of leverage stability do occur, but only infrequently.
- When stable leverage regimes occur, they largely arise at low leverage.
- Many firms have high and low leverage at different times, but few keep Debt/TA above 0.500 for long.
- Permanently high leverage is rare: 0.2% of firms listed 20 years keep Debt/TA always above 0.500.

# Post-WW II abandonment of conservative leverage: Constant composition sample





## **Firm fixed effects and stability of the leverage cross section**

- Mackay and Phillips (2005) and Lemmon, Roberts, and Zender (2008) find  $R^2$ s above 50% for firm fixed effects in panel leverage ANOVAs.
- LRZ's ANOVAs show  $R^2$ s of about 1% for year fixed effects.
- In LRZ, **firm** fixed effects account for **98%** of the explained variation vs. **2%** for **year** fixed effects.
- LRZ conclude that time-series factors are not likely to be important determinants of capital structure heterogeneity.

## **Caveats about significant firm fixed effects (FEs):**

- Firm FEs simply measure *average differences in leverage across firms* over the full sample period.
- They are not informative about leverage stability.
- They do not establish that firms have permanent leverage components or target leverage ratios.
- For example, significant firm FEs can be generated by simple pecking-order behavior when firms differ in external funding needs.
- Highly significant firm FEs and trivial year FEs emerge when leverage evolves *randomly* (generated in simulations by a 0-1 bounded transform of an underlying unit-root process).

## Concerns about firm fixed effect inferences, cont.

- Short panels: Over half of sample firms have 9 or fewer years of data on Compustat.
- Extant ANOVA results use purely additive specifications that have only main firm and time effects and exclude *firm-specific* time-series effects.
- Therefore, the only time-series effect that is captured in prior ANOVAs is *simultaneous* shifts in expected leverage for *all* firms.
- To capture firm-specific time-series variation requires inclusion of firm-time interaction effects.

## Adjusted R<sup>2</sup>s for firm fixed effects alone vs. model with firm-decade interactions

	Firm fixed effects alone	Firm-decade interactions included
DJIA 1926 to 2000	0.271	0.841
1931 to 2000	0.291	0.836
1941 to 2000	0.358	0.821
1951 to 2000	0.461	0.810
1961 to 2000	0.520	0.780
1971 to 2000	0.544	0.761
1981 to 2000	0.543	0.657
Constant comp sample	0.365	0.767
Firms listed 20+ years	0.471	0.709
Full sample	0.561	0.697

## Percent of explained variation: Firm fixed effects versus time-varying effects

	Firm-decade interaction effects	Firm fixed effects	Decade fixed effects
Full sample		98.8%	1.2%
	22.4%	76.8%	0.8%
Firms listed 20+ yrs		96.8%	3.2%
	37.8%	60.5%	1.7%
Const comp sample		79.2%	20.8%
	40.2%	47.4%	12.4%
DJIA sample		54.8%	45.2%
	41.4%	30.9%	27.7%

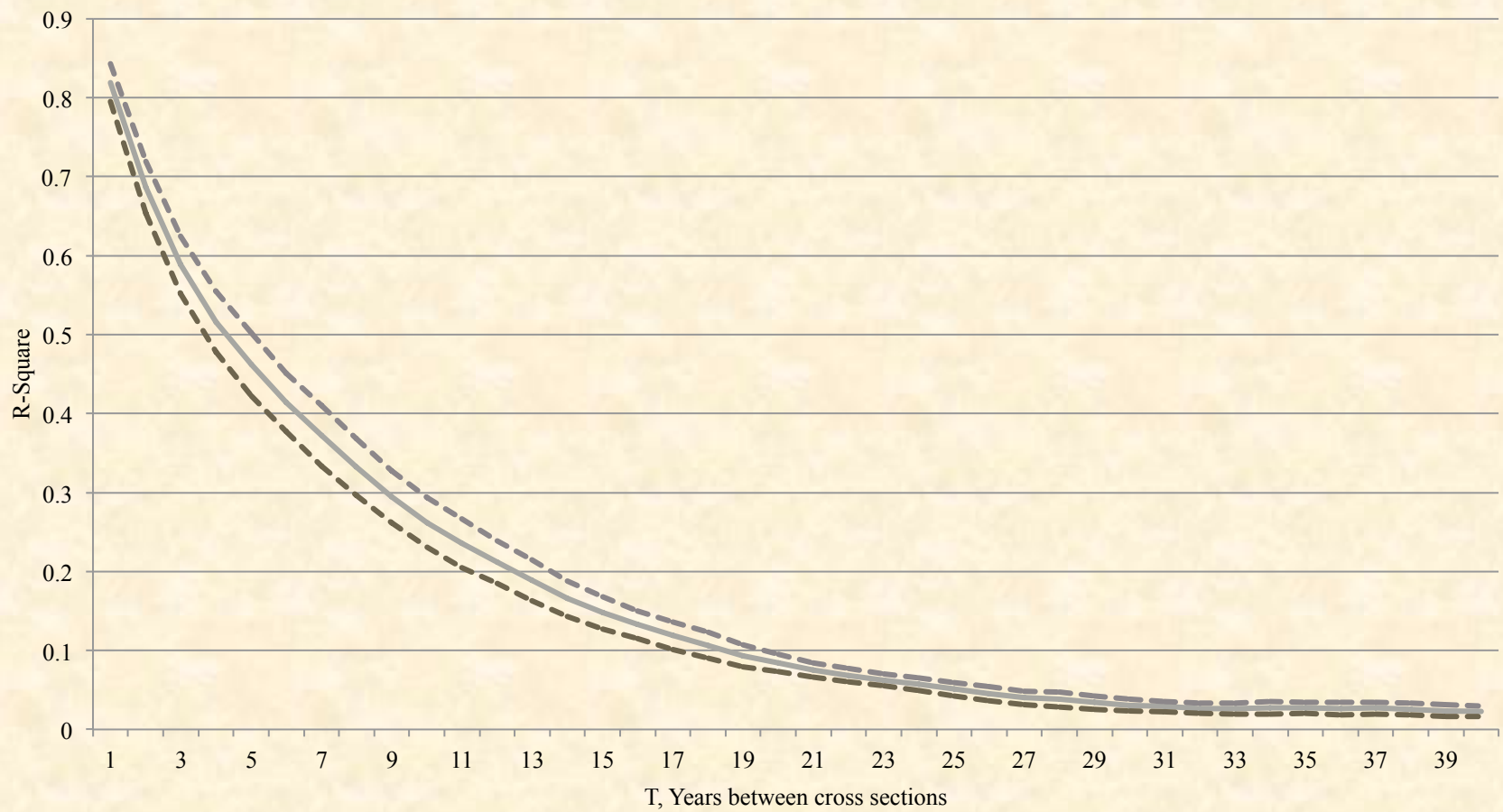
## **Key points from ANOVAs:**

- Time-series variation in leverage is systematically important.
- True for both:
  - firm-specific time-series variation.
  - common-to-all-firms time-series variation.

## **Gauging the extent of stability in the leverage cross section**

- Question: How similar are leverage cross sections 1, 2, 3,..., 19, etc. years apart?
- Panel  $R^2$ s are problematic: They capture an average effect over all sample years.
- We compare  $R^2$ s relating cross-sectional “slices” from different pairs of years.
- If observed, high  $R^2$ s for cross sections widely separated in time would indicate strong stability.

# R<sup>2</sup> between cross-sectional “slices” at different times





# Migration of firms over the leverage cross section: 20-year horizon

	Percent of firms
All 4 leverage quartiles	30.4%
3 or 4 leverage quartiles	69.5%
2 or more quartiles	92.8%
Always in same quartile	7.2%

# How well do these models match the instability of the actual leverage cross section?

- Neutral mutation (Miller (1977)): no targets, random evolution.
- Stationary target ratios with speeds-of-adjustment ranging from very slow to rapid.
- Time-varying target ratios with varying degrees of target volatility.
- Flexible target zones: Indifference over a range with weak rebalancing outside the range.
- Inflexible target zones: Indifference over a range with aggressive rebalancing outside the range.

# Leverage model structures

## Leverage

(logit transform of underlying state variable  $X_t$  implies 0-1 bounds)

$$L_t = \exp(X_t) / [1 + \exp(X_t)]$$

## Leverage generating process

( $\lambda$  is the speed of adjustment to the target ratio)

$$X_t = \lambda X^{target} + (1-\lambda)(X_{t-1} + \sigma \epsilon_t)$$

## Target ratio generating process

(time-varying target models)

$$X_t^{target} = \delta X^* + (1-\delta)(X_{t-1} + \zeta \epsilon_t)$$

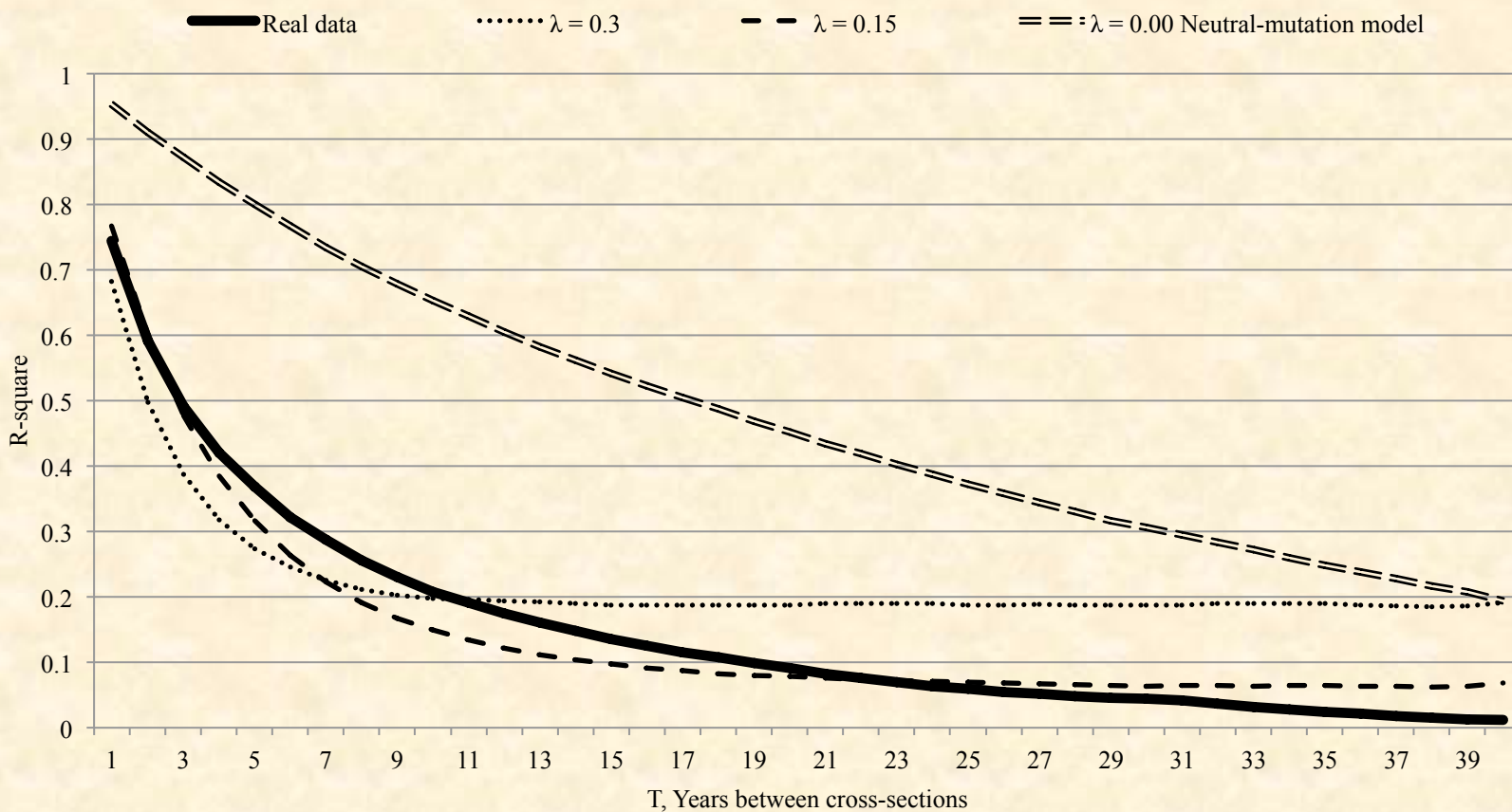
# Leverage model simulation structure

- For a given model type, specify a grid of parameter values (SOA, etc.).
- Require firm exit rates to match exit rates of the sample.
- Take a single point (parameter combination) from the grid.
- For each firm and start date, draw from unit normal and obtain leverage.
- Repeat the process for many firms and all future dates.
- Compile model-generated leverage cross sections for each date.
- Generate  $R^2$ s for pairs of model-generated cross-sectional “slices” that differ by 1, 2, 3, etc. years.

## Leverage model simulation structure, cont.

- Generate goodness-of-fit measure for model-generated  $R^2$  profile versus  $R^2$  profile for actual data.
- Repeat for all parameter combinations in the grid.
- Select the parameter combination with the closest  $R^2$  fit to the real data.
- Repeat the process for all model types.
- Compare goodness-of-fit measures for the closest fitting parameter combination of each model.

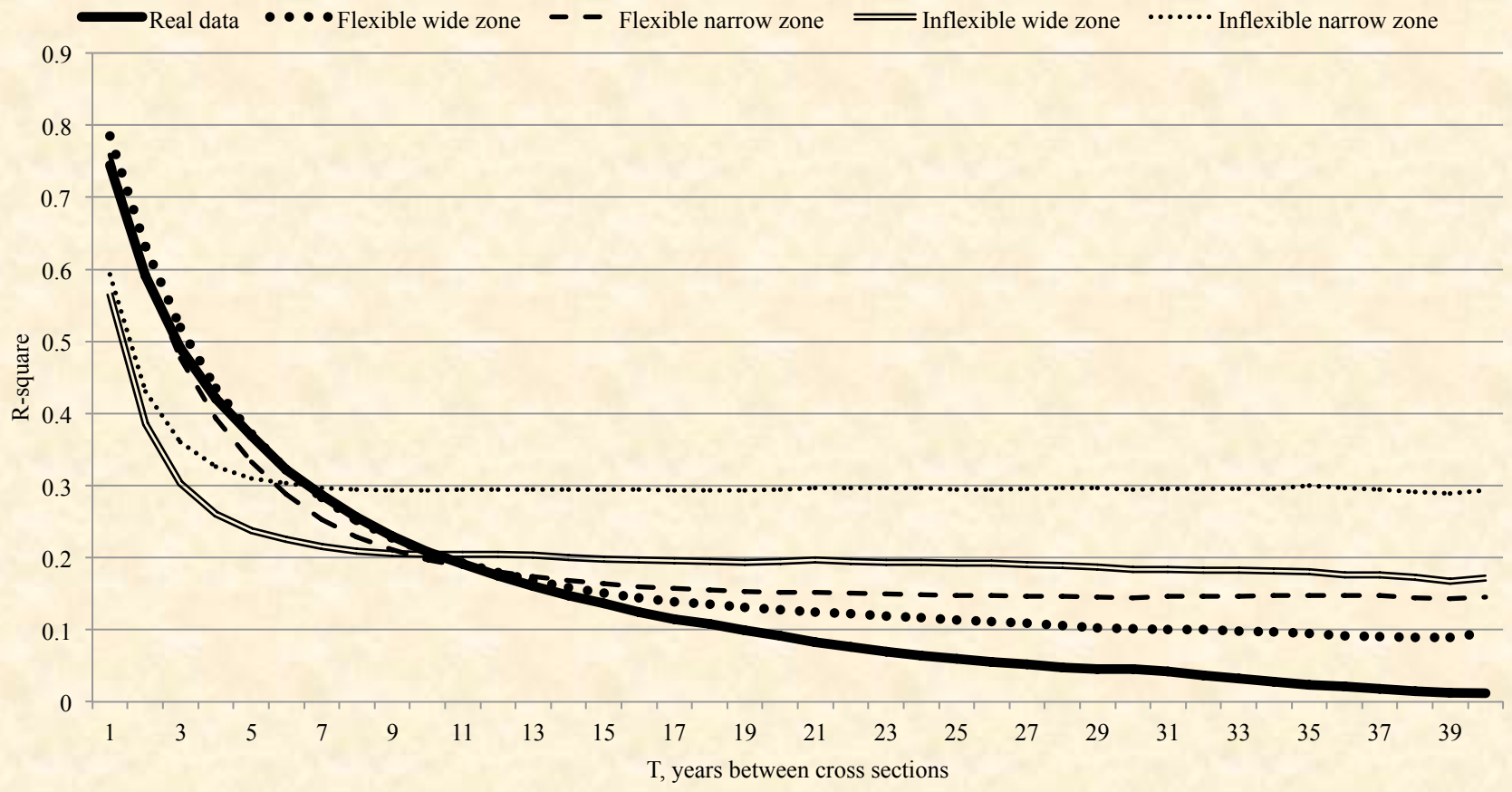
# Neutral-mutation model does terribly, SOA of 0.15 beats higher and lower SOAs



## **ANOVAs for simulated leverage data generated by random variation (underlying unit-root process)**

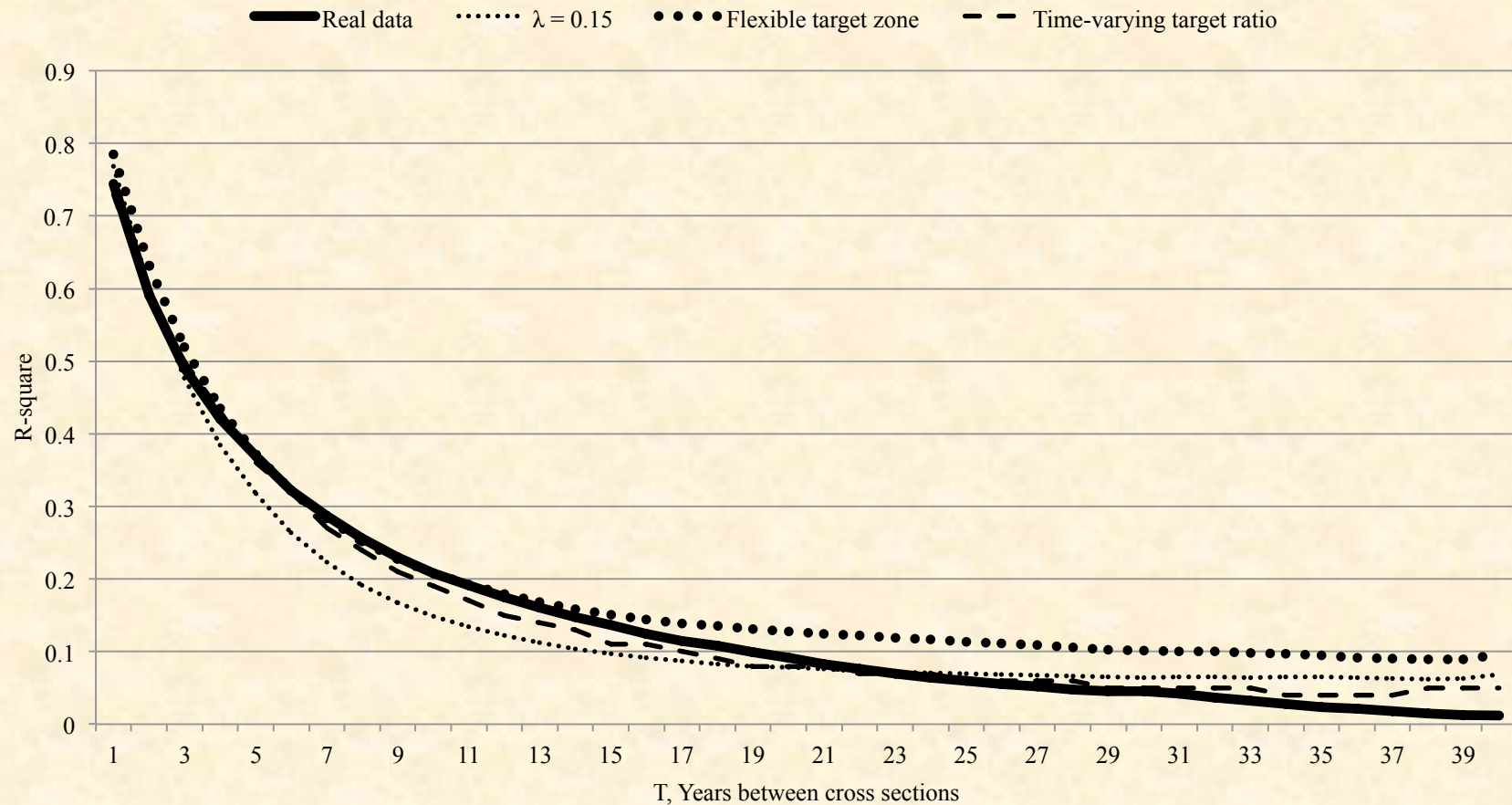
- $R^2$  for firm fixed effects alone is 77%.
- $R^2$  for year fixed effects alone is 1%.
- Hence highly significant firm fixed effects do not establish that firms have (roughly constant) target leverage ratios or targets of any type.
- Nor do they establish that capital structures have permanent leverage components.

# Flexible zones beat inflexible zones in replicating the instability of the leverage cross section





# Time-varying targets offer the best match, but the edge over models with target zones or slow SOAs to fixed targets is small



## **Capital structure models that do a good job matching the instability of the cross section:**

- Time-varying target ratios with a lot of target volatility.
- Target zones with flexible boundaries.
- Slow SOAs (near 15% per year) toward stationary target ratios.

## **Models that do a poor job matching the instability of the cross section:**

- No targeting, random evolution.
- More than weak incentives to rebalance toward stationary target ratios.
- Target zones with relatively inflexible boundaries.

## Industry-median leverage ratios

- They are the strongest known determinants of a firm's leverage (Frank and Goyal (2009)).
- We find wide variation in industry-median leverage at the 4-, 3-, and 2-digit SIC levels.
- ANOVAs show *industry-specific time-series* variation to be comparable in importance to (previously documented) *cross-industry* differences that exist at a given point in time.

# Industry-median leverage ratios vary widely

Time-series median	4-digit SIC	3-digit SIC	2-digit SIC
Range	0.414	0.394	0.319
Standard deviation	0.110	0.104	0.075

## Percent of explained variation in industry-median leverage: Time-varying vs. industry fixed effects

	4-digit SIC	3-digit SIC	2-digit SIC
Industry-decade interactions	45.3%	46.3%	36.3%
Industry fixed effects	52.1%	48.1%	57.1%
Decade fixed effects	2.6%	5.7%	6.6%

# **Are time-varying targets driving leverage instability?**

- We consider target estimates based on traditional determinants: Industry-median leverage, EBITDA, Log (sales), Market-to-book, Tangible assets.
- Findings: Leverage changes a lot more than targets change around departures from stable leverage regimes and attainment of peaks and troughs.
- Message: If time-varying target ratios are driving the evolution of capital structure, then we need to look for new target determinants beyond those traditionally considered.

## **Conjectures about what drives leverage instability**

- There are signs in the data that debt-funded expansion is important.
- Case studies (in the Internet Appendix) also show hints of the following at work:
  - Market timing/capital market conditions.
  - Follow-the-leader behavior.
  - Deleveraging to avoid distress.
  - Leveraging to fund payouts and deter takeovers.
  - Managerial uniqueness: Managing with style.



## **Is the capital structure puzzle mainly about explaining a largely stable leverage cross section?**

- No. Time-series and cross-firm variation in leverage are both systematically important.
- The issues of cross-firm and time-series variation are not separable: The cross section is far from stable over time.
- So, even if the objective is to explain the leverage cross section, attention to time-series determinants is necessary.

## **Bottom line for empirically credible theories of capital structure**

- Must be able to explain wide time-series variation in leverage.
- Targeting has a role to play, but it will be targeting in a sense that assigns little or no weight to remaining near a particular leverage ratio.
- Models that can explain the substantial instability of the actual leverage cross section:
  - time-varying target ratios that vary a lot.
  - target zones with flexible boundaries.
  - speeds of adjustment of around 15% per year to stationary target ratios.

## **Unresolved issue: Which of two broad views is more descriptive?**

- View #1: A firm's leverage ratio matters at each point in time, but the specific way it matters changes a lot over time.
- Research challenge: Identify the key factors that generate substantial time-series volatility in target leverage ratios.

## **Unresolved issue: Which of two broad views is more descriptive?**

- View #2: Over a reasonably wide range, a firm's specific leverage ratio is at most of second-order importance.
- Example: Firms have target zones with (i) leverage dynamics inside the zone driven by factors not directly related to leverage, and with (ii) rebalancing incentives if shocks move leverage outside the zone.
- Research challenge: Identify the factors (e.g., investment, payout, and capital-access considerations) that dictate that leverage behaves as a residual inside the zone.