Debt Covenants and the Macroeconomy: The Interest Coverage Channel

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Introduction

- Non-residential investment is a key driver of monetary policy response.
  - Natural link: $6T corporate debt market.
  - Large body of work on transmission through credit limits ("financial accelerator").
- Firm credit limits typically modeled as caps on market leverage.
  - But actual covenants observed in debt contracts are quite different.
  - Lian and Ma (2018): importance of earnings based constraints.
  - But many covenants depend on more than earnings, firms often have several at once.
- **Research question:** how does firm credit limit structure influence macro dynamics?
  - Focus on **Interest Coverage (IC)** covenants that limit ratio of interest payments to earnings.

This Paper

- **Approach**: combine structural model with firm-level empirical evidence.
- **Stylized Facts**: Interest Coverage covenants extremely common (seen in 84% of firms in DealScan sample with covenants), maximum ratios appear stable over time.
- **Main Finding #1**: Interest Coverage covenants amplify interest rate transmission.
  - Much stronger responses of debt, investment, output than under alternative covenant types.
  - Reason: implied limits directly shifted by interest rates.
  - Data: $r_t \downarrow 100\text{bp} \implies$ extra 9.5% 8Q asset growth for firms with IC covenants only.
- **Main Finding #2**: Combination of IC + limit on stock of debt $\implies$ state dependence.
  - Stronger transmission when rates are already high (and IC covenants are tighter).
  - Estimated share with IC as tightest covenant varied from 7% to 60% over 1997-2007 period.
  - Data: $r_t \downarrow 100\text{bp} \implies$ extra 2.1% 8Q asset growth for firms w/ these covs when r_{t-1} 100bp higher.

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Literature Review

- **Corporate Finance + Covenants:** Almeida Campello (2007), Bradley Roberts (2004), Chava Roberts (2008), Chaney Sraer Thesmar (2012), Chodorow-Reich Falato (2017), Demerjian Owens (2019), Diamond Hu Rajan (2017), Donaldson Gromb Piacentino (2018), Garleanu Zweibel (2009), Green (2018), Ivashina Vallee (2019), Leland (2004), Murfin (2012), Nini Smith Sufi (2009), Rauh Sufi (2010), Roberts Sufi (2009), Xiang (2019).

  Here: Focus on macro dynamics, interest rate transmission.

- **Financial Frictions:** Bernanke Gertler (1989), Bernanke Gertler Gilchrist (1999), Christiano Motto Rostagno (2014), Cloyne Ferreira Froemel Surico (2018), Curdia Woodford (2010), Jeenas (2019), Jermann Quadrini (2012), Kiyotaki Moore (1997), Ottonello Winberry (2018).

  Here: Role of covenant structure in strength of transmission.

- **Covenants and Transmission:** Drechsel (2019), Lian Ma (2018).

  Here: Effect of interest coverage, state dependence through covenant interactions.

Background: Debt Covenants

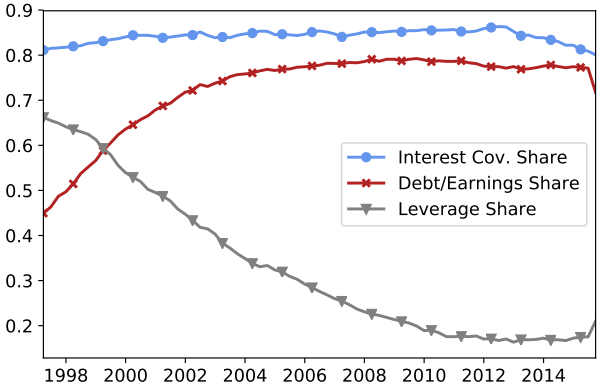
- **Covenants:** provide conditions that, if violated by the firm, allow lender to demand accelerated repayment.
  - Often set thresholds for financial ratios $\implies$ debt limits.
- **Purpose:** help firm commit not to overlever on other loans, provide "tripwires" for lender to reassess investment, seize control rights.
- Three main types (B_t denotes debt):
  1. **Interest Coverage (IC):** $r_t B_t \leq \theta^{IC} \cdot \text{EBITDA}_t$.
  2. **Debt/Earnings (DE):** $B_t \leq \theta^{DE} \cdot \text{EBITDA}_t$.
  3. **Leverage:** $B_t \leq \theta^{LEV} BV_{t-1} \simeq \theta^{LEV} K_{t-1}$.
- Only interest coverage directly shifted by interest rates.

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Covenant Prevalence by Type

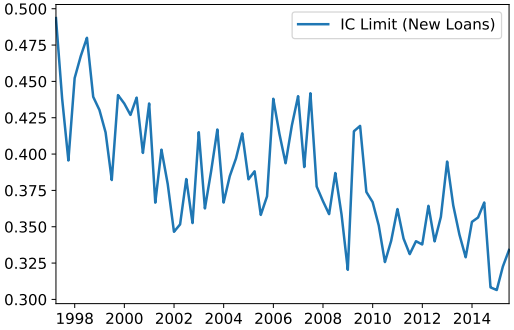
- Plot: share with each covenant type for firms with at least one DealScan covenant.
- Share with Interest Coverage covenant high and stable over time.



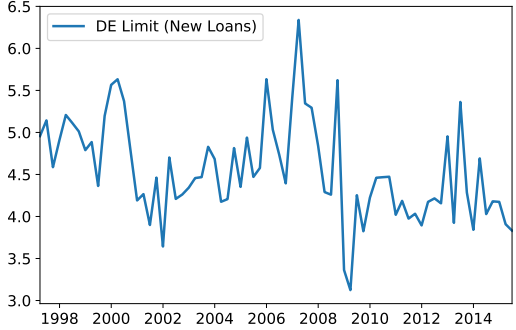
Source: DealScan. Shares are equally weighted among DealScan firms with at least one covenant.

Covenant Ratios Over Time

- Complication: covenant limits are endogenously set.
  - Do lenders simply adjust thresholds when interest rates or earnings change?



(a) Interest/EBITDA Ratio

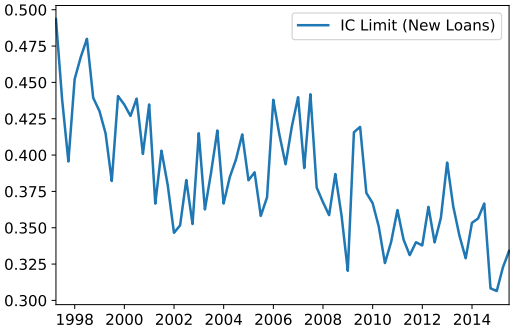


(b) Debt/EBITDA Ratio

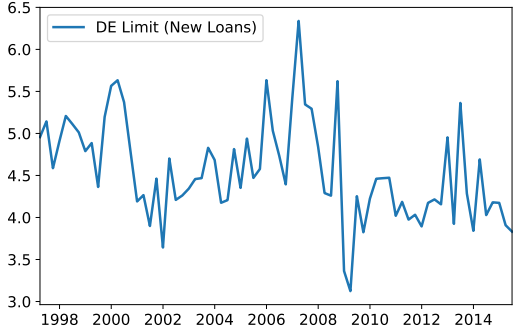
Source: DealScan, Compustat. Limits for new loans are weighted by deal size.

Covenant Ratios Over Time

- Below: initial covenant ratios at origination in DealScan.
  - Average across loans, weighted by deal amount.



(a) Interest/EBITDA Ratio

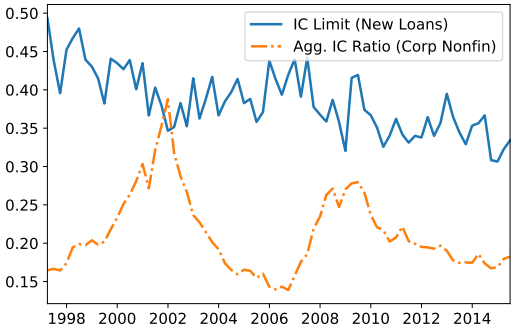


(b) Debt/EBITDA Ratio

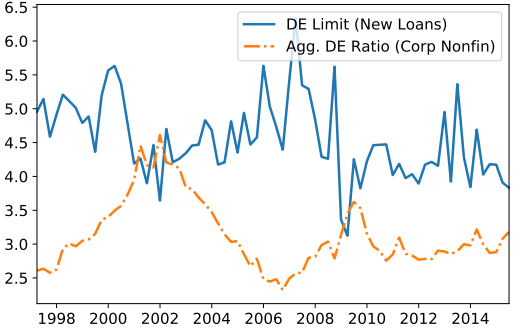
Source: DealScan, Compustat. Limits for new loans are weighted by deal size.

Covenant Ratios Over Time

- Compare to corresponding ratios for corporate nonfinancial sector.
  - Slightly noisy, but little comovement with underlying economic fundamentals.



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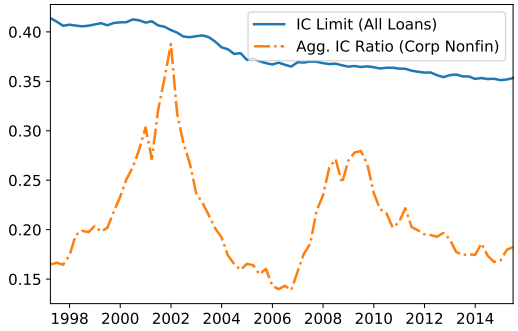


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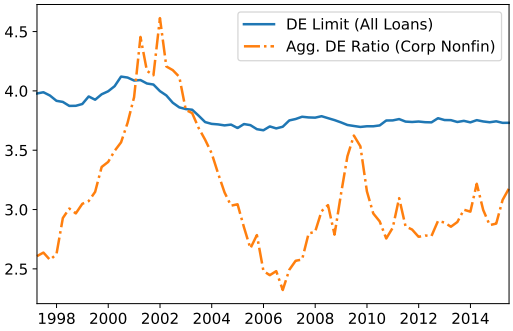
Source: DealScan, NIPA, Flow of Funds. Limits for new loans are weighted by deal size.

Covenant Ratios Over Time

- Now look at all active covenants. Provide smooth and stable constraints over time.
  - Reasonable to consider thresholds fixed at business cycle frequency.



(a) Interest/EBITDA Ratio



(b) Debt/EBITDA Ratio

Source: DealScan, NIPA, Flow of Funds. Limits for new loans are weighted by deal size.

Model Overview

- Demographics and preferences
  - Risk-neutral representative **saver** lends to firms and provides labor: $u^S(C,N) = C - \eta N$.
  - Representative **entrepreneur** owns firms and consumes dividends: $u^E(D) = \log(D)$.
  - Interest rate variation $\implies$ time varying discount factor (both agents):

$$\log \beta_t = (1-\rho_\beta)\log\bar{\beta} + \rho_\beta \beta_{t-1} + \varepsilon_{\beta,t}.$$

- Representative firm owns capital and pays dividends to entrepreneur.
  - Borrows in risk-free floating rate debt at rate r_t (s.t. covenants), interest is **tax deductible**.
  - Concave entrepreneur utility $\implies$ dividend smoothing motive (**financing frictions**).
  - Combined: pathway from debt limits $\rightarrow$ debt $\rightarrow$ investment.

- Overall debt limit is smoothed to allow for e.g., annual financial statistics:

$$B_t \leq \rho \bar{B}_t + (1-\rho)\pi_t^{-1} B_{t-1}$$

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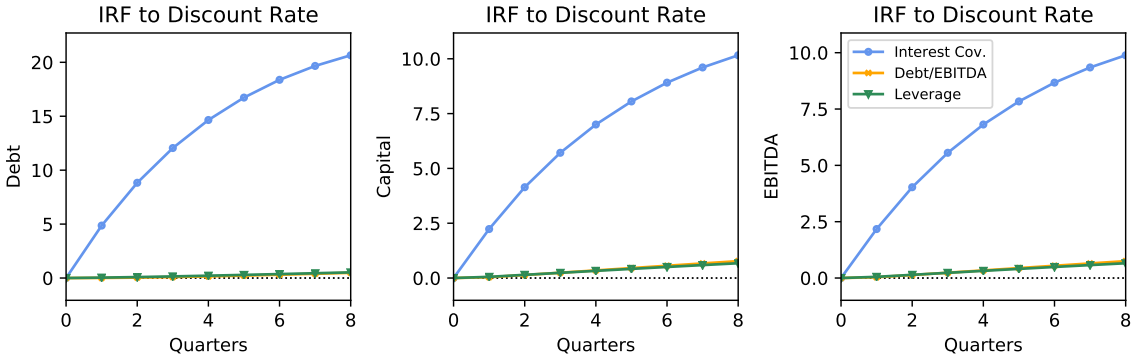
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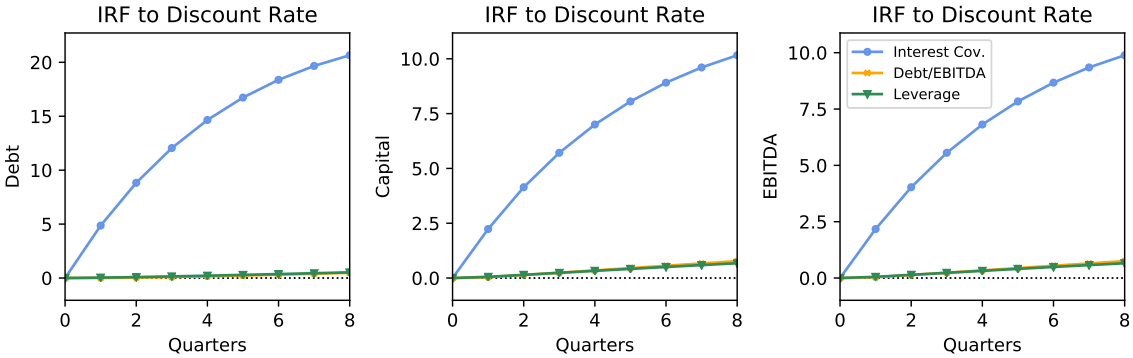
Comparison: Covenant Types

- **Main Result #1**: Interest Coverage covenants amplify interest rate transmission.
- Compare linearized IRF to ↓ 100bp disc. rate shock to firms each with single covenant.



Comparison: Covenant Types

- Additional 8Q growth of debt (20.2%), capital (9.4%), EBITDA (9.1%) relative to DE econ.
- IC economy: large relaxation of debt limits $\Longrightarrow$ capital, EBITDA growth $\Longrightarrow$ feedback.



Data Construction

- Data: merged Dealscan (syndicated loan covenants) and Compustat (firm data).
  - Sample: 1997 to 2007.
  - Drop finance + real estate, public utilities, public administration, mining, construction.
- Restrict sample to firms with above-quarter-median assets and profit margin.
  - These are the firms likely able to sustain earnings based covenants (Lian and Ma, 2018).
  - Comprises 29% of firms, but 67% of sales.
  - 60% of this sample has at least one active Dealscan covenant in a given quarter.

Empirical Approach

- Main specification:

$$y_{i,t+h} = \alpha_i + \phi_{ind,t} + \sum_{\text{cov}} \mathbb{I}_{\text{cov},t} \cdot (\beta_{0,\text{cov}} + \beta_{1,\text{cov}} \Delta r_t) + \gamma' X_{i,t-1} + \delta'(X_{i,t-1} \cdot \Delta r_t) + \varepsilon_{i,t}$$

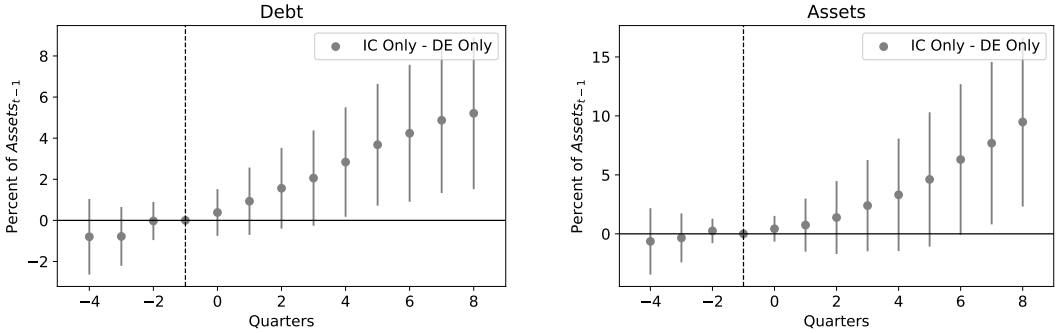
  where r_t is 3-Month T-Bill, outcome $y_{i,t+h}$ and controls $X_{i,t-1}$ are scaled by $Asset_{i,t-1}$.

- Challenge #1: Interest rate changes are not exogenous (identified MP shocks too weak).
  - Industry-time (SIC-2) effects attempt to control for endogeneity of interest rate.

- Challenge #2: covenants (and syndicated loans) are not randomly assigned.
  - Interact Δr_t and controls
  - Directly compare firms with IC and DE covenants.

Empirical Evidence: Covenant Types

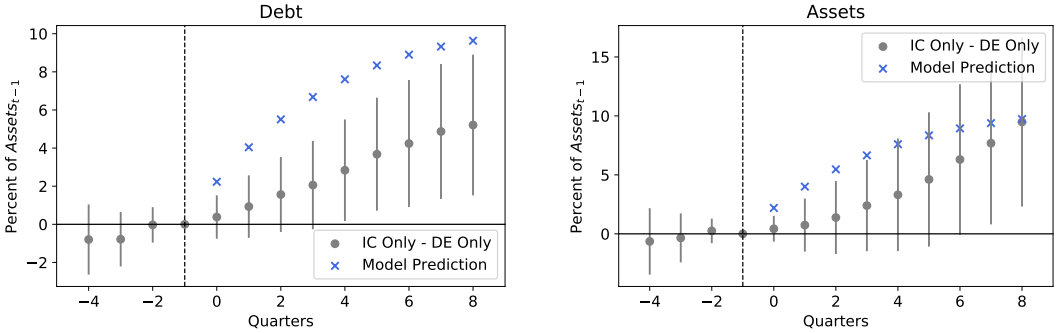
- Plots: difference in response to $r \downarrow$ 100bp between IC-Only, DE-Only: $-(\beta_{1,IC} - \beta_{1,DE})$.
- IC-Only show additional 8Q growth in debt (5.2%), assets (9.5%) as share of $Assets_{t-1}$.



Source: DealScan, Compustat. The sample spans 1997Q1 to 2007Q4. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels.

Empirical Evidence: Covenant Types

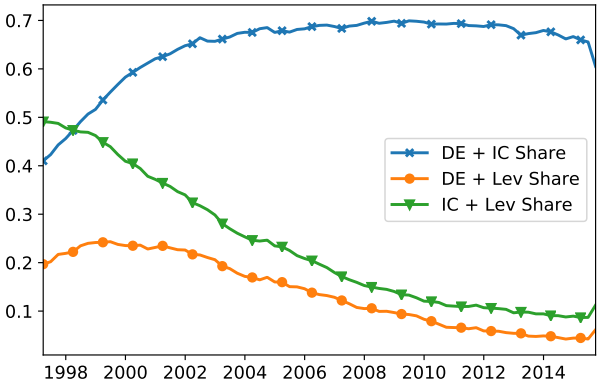
- Are these numbers reasonable? Compare to model prediction.
- Close to model response of assets (9.7%), smaller than prediction for debt (9.6%).



Source: DealScan, Compustat. The sample spans 1997Q1 to 2007Q4. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels.

Multiple Covenants

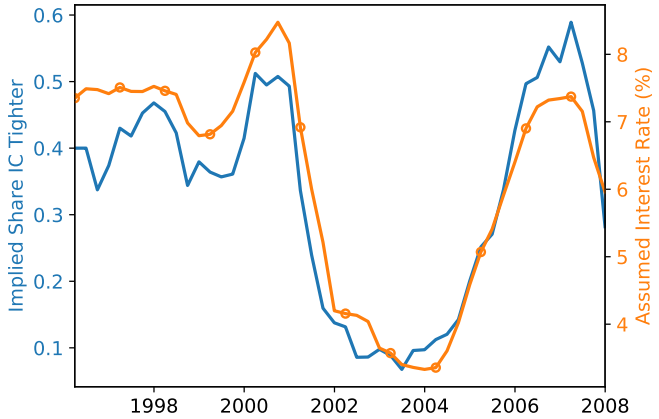
- Previous analysis considers economies with a single covenant at a time.
- Data: most firms with any covenants have **both** Interest Coverage + Debt/Earnings.



Source: DealScan. Shares are equally weighted among DealScan firms with at least one covenant.

Covenant Tightness

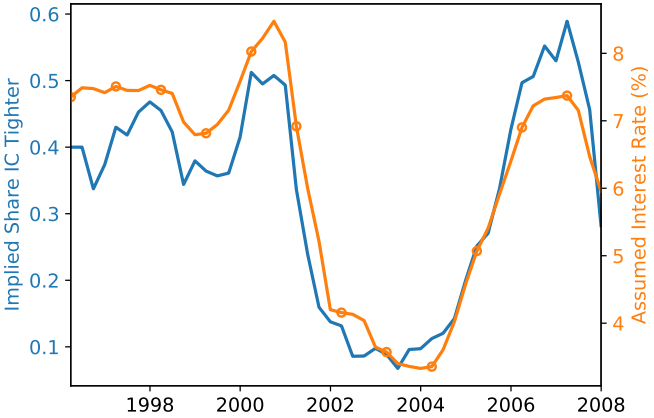
- Which is tighter? Challenge: firms keep excess debt capacity to avoid violation.
  - Compute closest covenant adjusting for differential violation risk following Murfin (2012).



Source: DealScan, Compustat, equally weighted.

Covenant Tightness

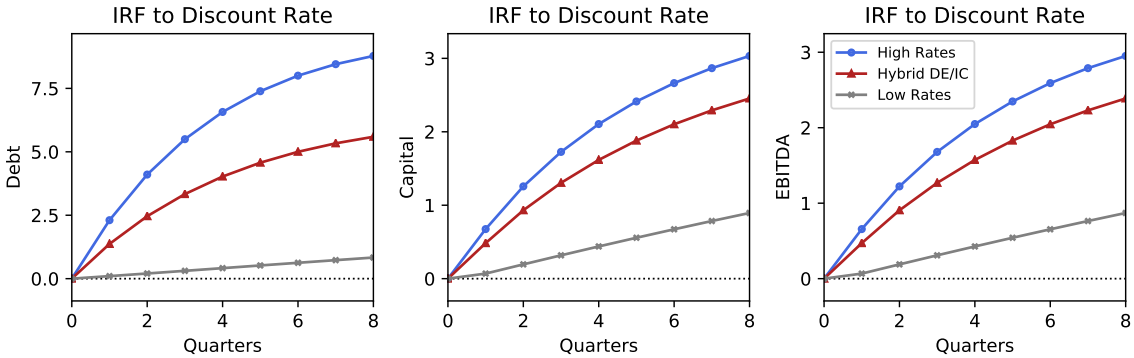
- Apply to Dealscan data $\implies$ large variation in implied fraction with IC as tightest covenant.
  - Average of 32.9%, but ranges from high of 58.9% in 2007 Q1 to low of 6.8% in 2003 Q2 .



Source: DealScan, Compustat, equally weighted.

State Dependence: DE + IC Covenants

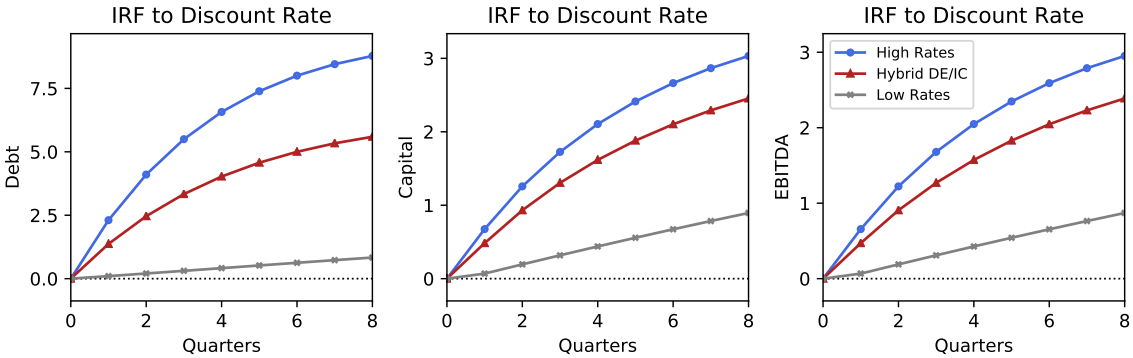
- **Main Result #2:** Combining IC + DE covs $\implies$ **state dependent** interest rate transmission.
- Adapt model to allow for both covs, dispersion in relative tightness $\theta^{IC}_{i,t}/\theta^{DE}_{i,t}$.
- IRF in alternative regimes with SS interest (discount) rate high (+250bp) vs. low (-250bp).



Additional Variables

State Dependence: DE + IC Covenants

- Stronger transmission when rates are high (73.4% IC binds) vs. low (1.3% IC binds).
- Additional 8Q growth in debt (7.9%), capital (2.1%) in high vs. low rate regime.
- Note: larger response under high rates despite smaller **proportional** change.

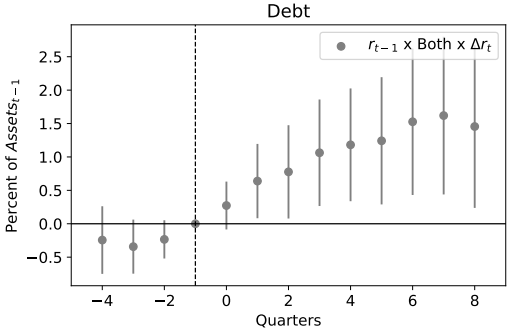


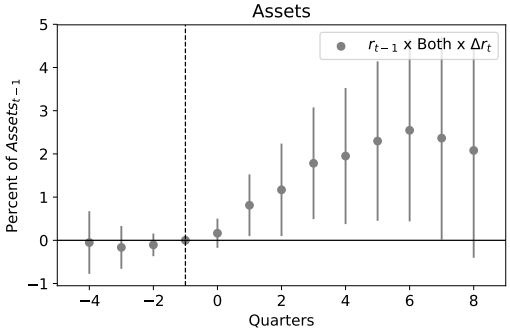
Additional Variables

Empirics: State Dependence

- Augment original regression so all variables are interacted with interest rate

$$y_{i,t+h} = \alpha_i + \phi_{ind,t} + \sum_{s\in\{0,1\}} \left(\mathbb{I}_0 + \mathbb{I}_1 r_{t-1}\right) \left\{ \sum_{\text{cov}} \mathbb{I}_{\text{cov},t} \cdot \left(\beta^s_{0,\text{cov}} + \beta^s_{1,\text{cov}} \Delta r_t\right) + \gamma'_s X_{t-1} + \delta'_s (X_{t-1} \cdot \Delta r_t) \right\} + \varepsilon_{i,t}$$

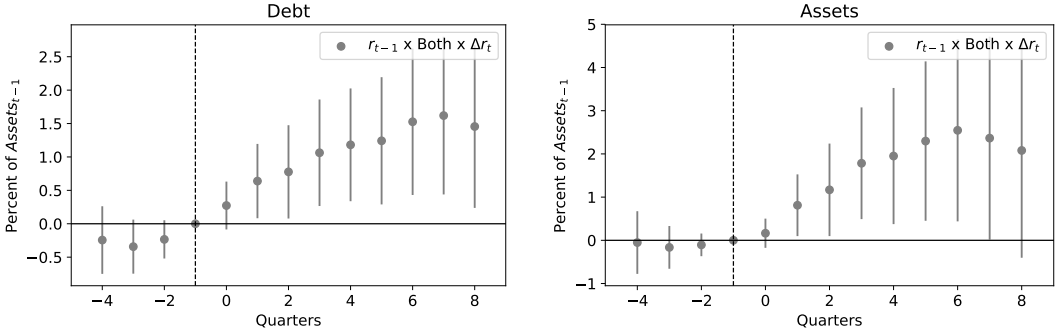




Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4. ▸ By Regime

Empirics: State Dependence

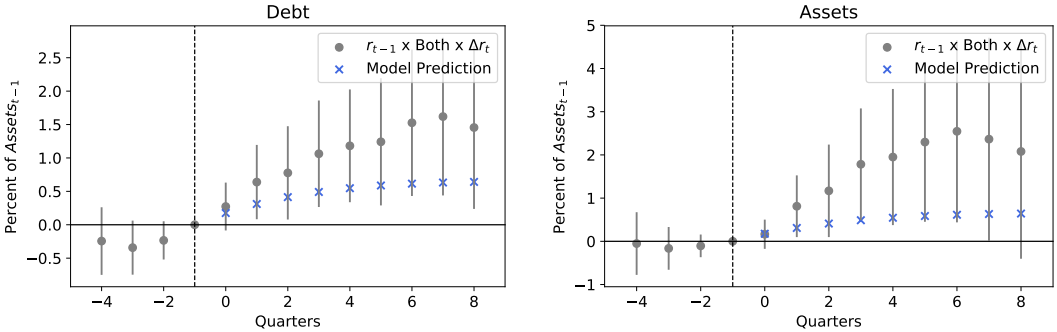
- Focus on interaction between r_{t-1}, having both IC + DE covenants, Δr_t.
- Increased 8Q growth in debt (1.5%), assets (2.1%) for every 1ppt increase in r_{t-1}.



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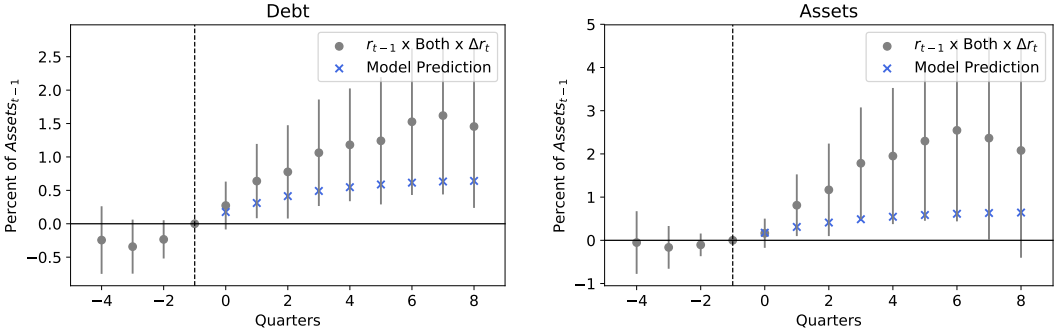
- Focus on interaction between r_{t-1}, having both IC + DE covenants, Δr_t.
- Increased 8Q growth in debt (1.5%), assets (2.1%) for every 1ppt increase in r_{t-1}.
- Point estimates $\sim$ 3x larger than model predictions for debt (0.6%), assets (0.6%).



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Empirics: State Dependence

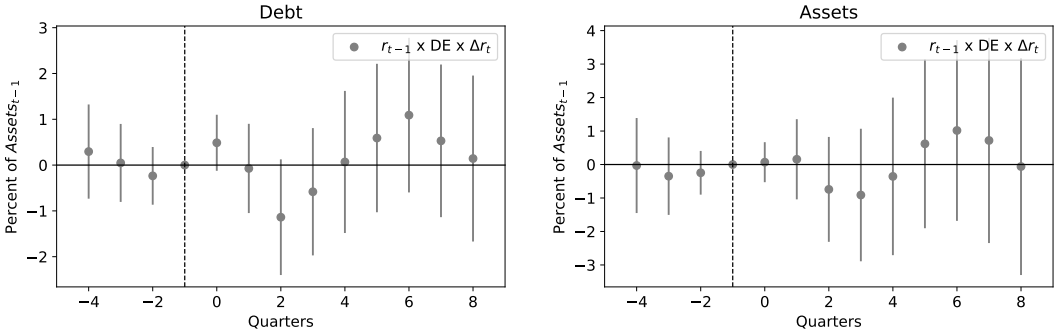
- What could explain stronger response in the data?
  - Spreads could move more than 1-for-1 with interest rate (e.g., "performance pricing").
  - Interest rate volatility higher when rates are high (e.g., Cox Ingersoll Ross, 1985).



Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4. ▸ By Regime

Empirics: State Dependence

- State dependence unique to firms with debt covenants, as predicted.
- Below: no state dependent response for firms with DE covenant only.



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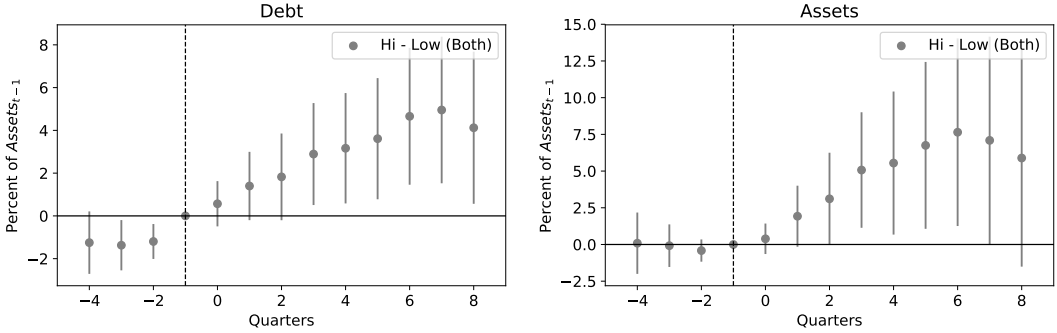
Conclusion

- Novel model capturing key facts about corporate debt limits.
  - Interest Coverage limits are extremely common, caps stable over time.
  - Typical firm has multiple covenants.
  - Large implied variation in share with IC as tightest covenant.
- Main results:
  - Interest Coverage covenants amplify interest rate transmission (**interest coverage channel**).
  - **State dependent** transmission: stronger when rates are high.
- Looking ahead:
  - Fixed rate debt: weaker but more path dependent transmission.

Empirics: State Dependence, High vs. Low Rate Regimes

- Augment original regression so coefficients depend on interest rate regime (cutoff = 3.56%):

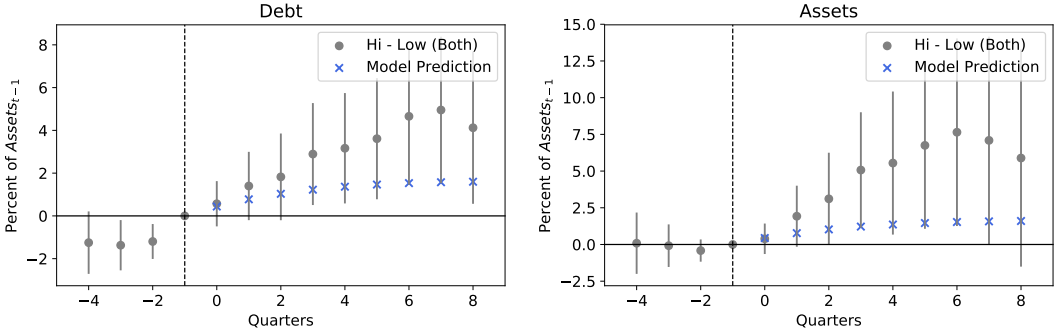
$$y_{i,t+h} = \alpha_i + \phi_{ind,t} + \sum_{s \in \{\text{hi, low}\}} \mathbb{I}_{s,t} \left\{ \sum_{\text{cov}} \mathbb{I}_{\text{cov},t} \cdot \left(\beta^s_{0,\text{cov}} + \beta^s_{1,\text{cov}} \Delta r_t \right) + \gamma_s' X_{t-1} + \delta_s' (X_{t-1} \cdot \Delta r_t) \right\} + \varepsilon_{i,t}$$



Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4. ▸ Back

Empirics: State Dependence, High vs. Low Rate Regimes

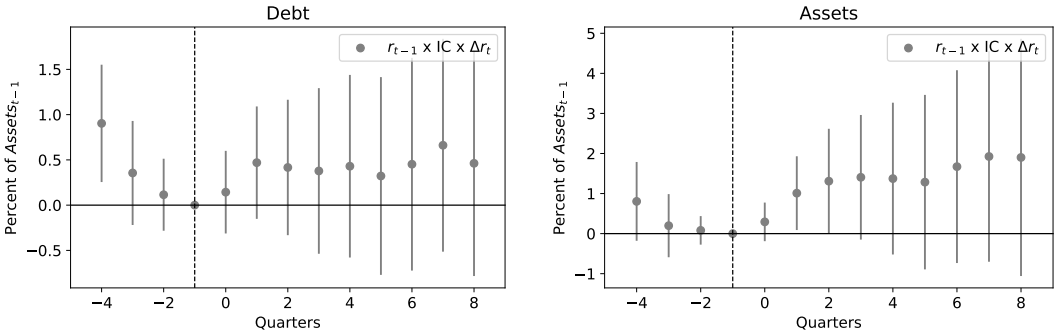
- Larger response when rates are high vs. low.
- Again, estimates are substantially larger than predicted.



Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4. Back

Empirics: State Dependence

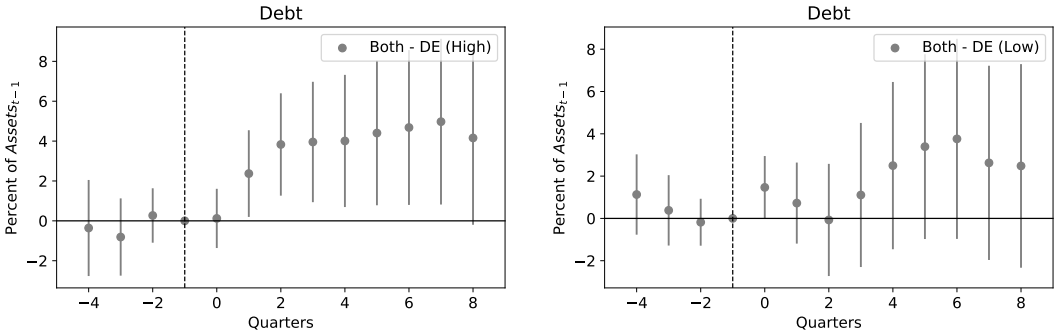
- Lower estimated state dependence for IC-Only firms, as predicted.
- Some positive effect unsurprising as constraints are tighter when rates high (unlike for DE).



Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4.

Empirics: State Dependence, High vs. Low Rate Regimes

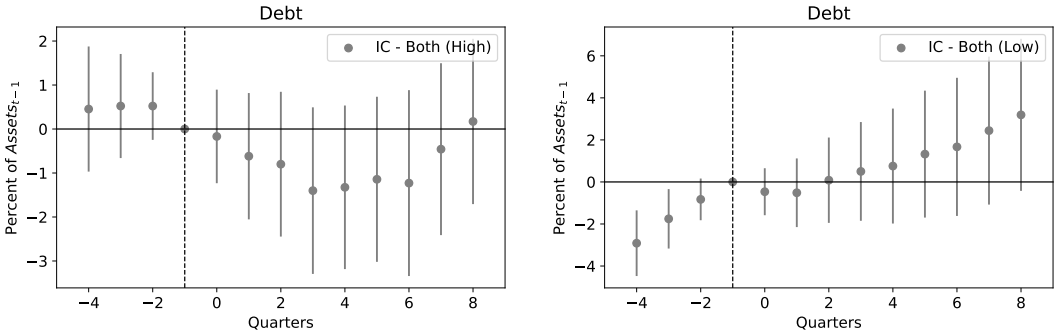
- Split sample by whether rates are high or low (cutoff: T-Bill rate = 3.56%).
- Both firms borrow more than DE-Only firms when rates high, similar when rates low.



Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4.

Empirics: State Dependence, High vs. Low Rate Regimes

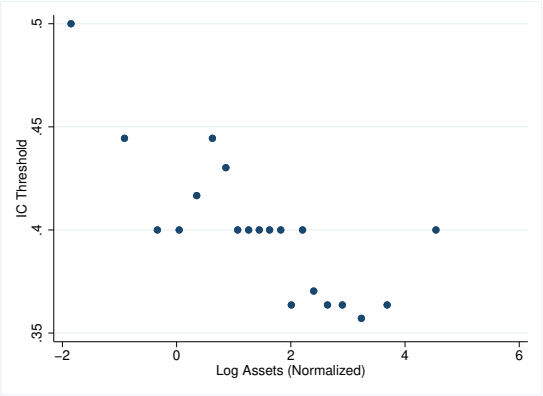
- Split sample by whether rates are high or low (cutoff: T-Bill rate = 3.56%).
- Reverse pattern for Both vs. IC-Only, matching theory.

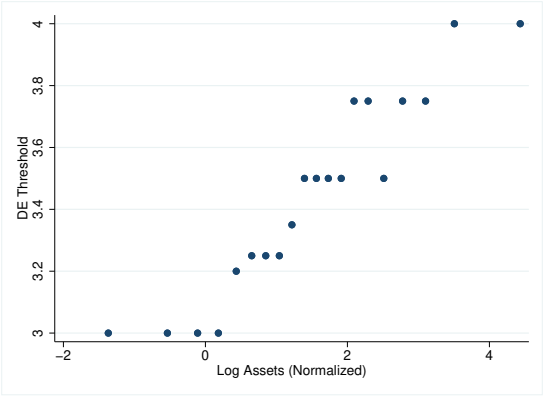


Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4.

What Determines Covenant Tightness?

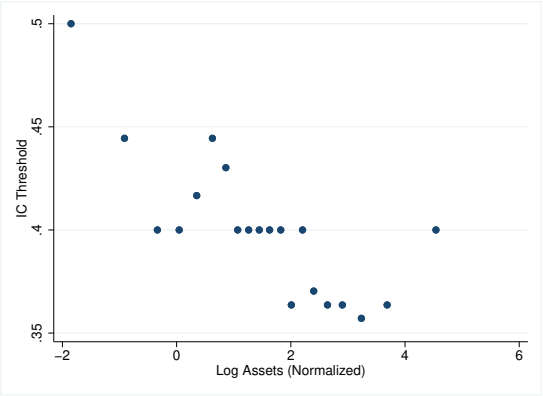
- Previous conjecture explains why firm might have both covenants, but not dispersion in relative tightness.
  - Below: θ^{IC} and θ^{DE} ratios on existing loans, by log assets (normalized by quarter median).

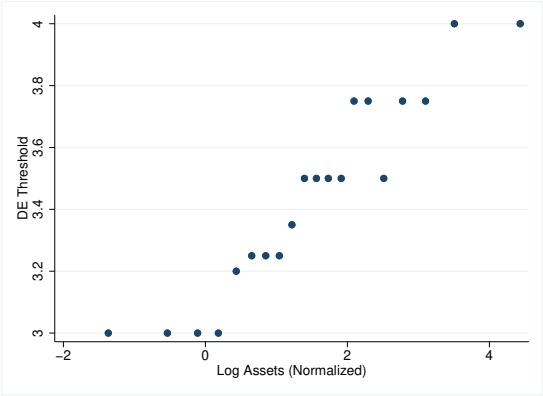




What Determines Covenant Tightness?

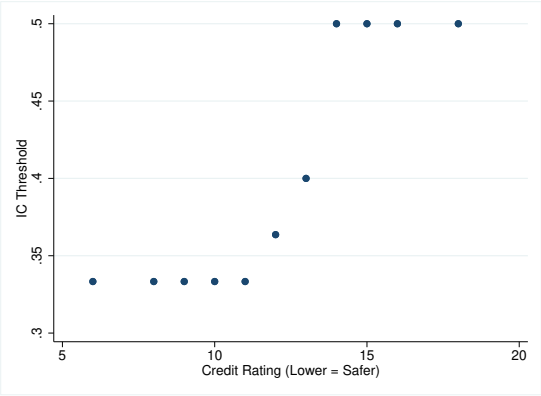
- Larger firms tend to have looser DE thresholds, but **tighter** IC thresholds.
  - Explained by higher spreads on smaller firms?

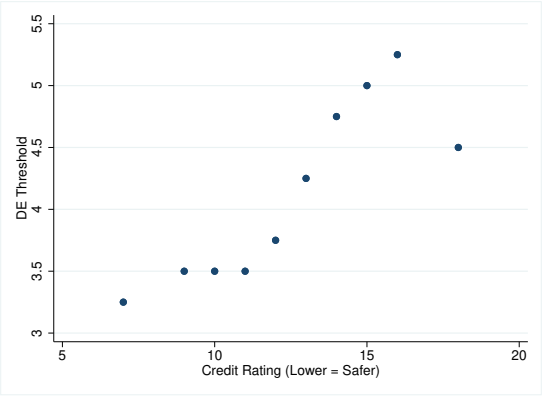




What Determines Covenant Tightness?

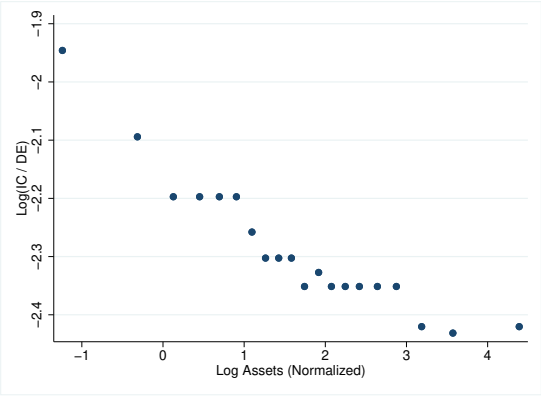
- Sorting by credit rating even more confusing (both looser for lower rating).
  - Related to selection into covenants for investment-grade firms in the first place?

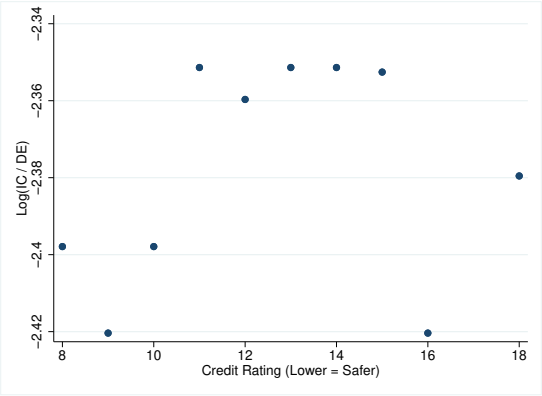




What Determines Covenant Tightness?

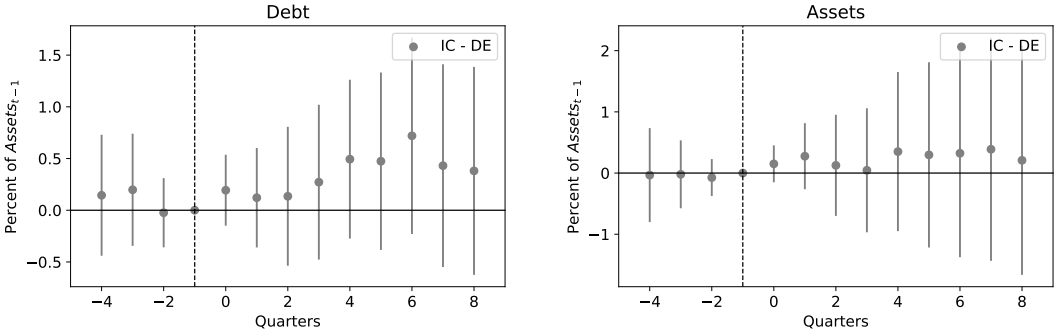
- Comparing limits: IC relatively tighter for large firms (effect of rating less clear).
  - Does this matter for transmission?





Monetary Policy Shocks

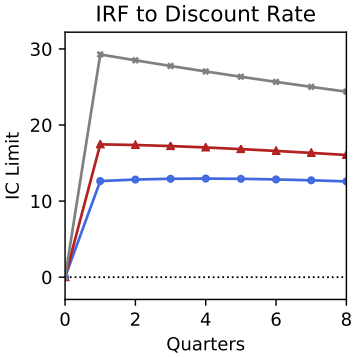
- Replace Δr_t with identified MP shocks following Gertler and Karadi (2012)

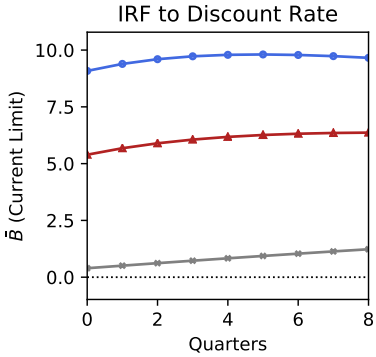


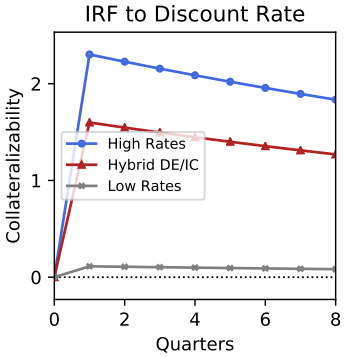
Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4. Back

State Dependence: DE + IC Covenants

- Larger response despite smaller proportional change in rates, debt limit.



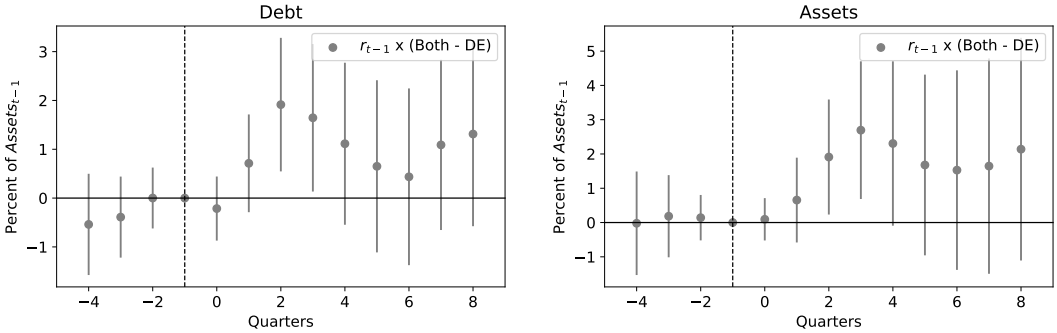




Back

Empirics: State Dependence

- Alternative measure of state dependence: diff-in-diff of Both relative to DE-Only
- Noisier, but still shows excess state dependence for Both firms.



Source: DealScan, Compustat. Error bars denote 95% confidence interval. Standard errors are double clustered at the firm and industry-time levels. The sample spans 1997Q1 to 2007Q4. Back

Representative Household's Problem

- Rep. household chooses consumption C_t, labor supply N_t and new debt B_t to maximize

$$V^S(B_{t-1}) = u(C_t) - v(N_t) + \beta E_t\left[V^S(B_t)\right]$$

subject to the budget constraint

$$C_t = \underbrace{(1-\tau)w_t N_t}_{\text{labor income}} + \underbrace{r_t \pi_t^{-1} B_{t-1}}_{\text{interest payment}} - \underbrace{\left(B_t^* - \pi_t^{-1} B_{t-1}\right)}_{\text{net debt issuance}} + \underbrace{T_t^S}_{\text{transfer}}$$

Back