The Bank as Grim Reaper

Debt composition and recoveries on defaulted debt

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Overview

- Recovery as neglected step-sister of default in credit risk literature.
- Observed recovery rates poorly explained in existing structural (Merton 1974) models.
  - Specified exogeneously in reduced-form (Duffie & Singleton 1999) models.
- We offer a structural model in which recovery is determined endogeneously.
  - Model puts special emphasis on the role of banks in credit markets in "pulling the plug" on deeply distressed borrowers.
  - Model of independent interest as complement to strategic default literature, which highlights role of equity holders.
- Key testable implication: firm-level recovery rate is increasing with share of bank loans in total firm debt.
- We find strong empirical evidence in support.

Recovery rates by seniority class

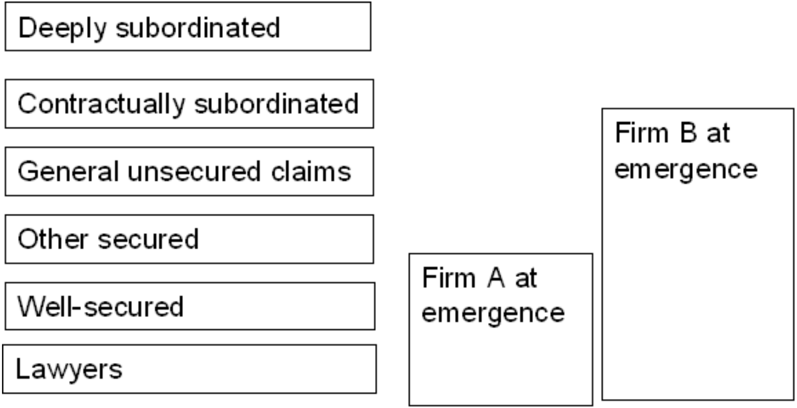
Seniority	Mean	Std Dev
Senior secured	53.80	26.86
Senior unsecured	51.13	25.45
Senior subordinated	38.52	23.81
Subordinated	32.74	20.18
Junior subordinated	17.09	10.90

Recovery rate measured as post-default market price.
Source: Carty & Lieberman (1996) analysis of Moody's data.

Instrument-level vs Firm-level recovery

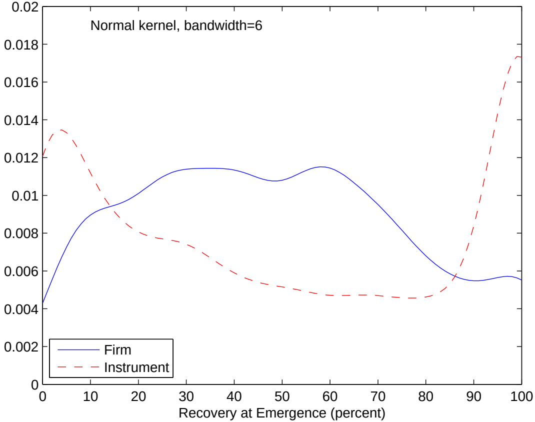
- Recovery literature has focused on explaining performance at instrument level.
- But debt claims on defaulted firms are collar options on the borrower's assets.
- Cannot properly assess expected recovery for an instrument independently from its place in the capital structure.
- Seniority "label" is of secondary importance (Keisman).
- Following Hamilton & Carty (1999), we study firm-level recovery.

Debt instruments as collar options



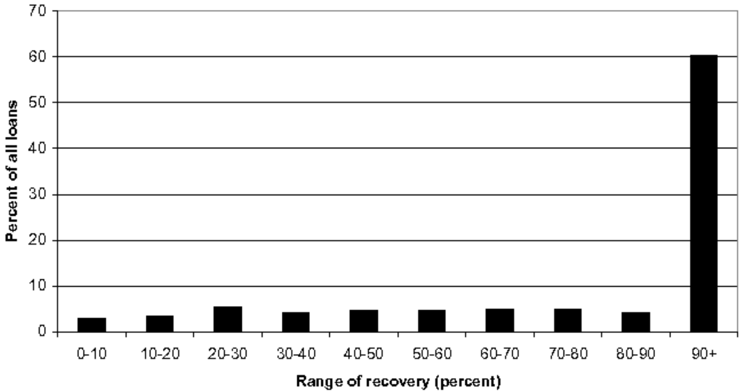
Seniority Class of Claim **Value of Firm at Emergence**

Firm-level vs. Instrument-level Recovery



Recovery at emergence from S&P LossStat database.

Distribution of bank debt recoveries



Recovery at emergence from S&P LossStat database. Median 97%.

How should recovery be defined?

- Post-default market price.
  - Ideal measure when distressed debt is traded in a liquid market.
  - Nearly all previous studies based exclusively on this measure.
- Recovery at emergence.
  - Might be in cash (liquidation) or new securities (reorganization).
  - Main problem is rate at which to discount back to date of default.
  - Best data available on non-traded or thinly traded instruments.
- Correlation between two measures is surprisingly low.

Exogeneous default threshold

- Black & Cox (1976) model underpins most modern structural approaches (academic and practitioner).
  - Asset value V_t follows GBM.
  - Default occurs when V_t makes first-passage across the default threshold.
- B&C formally treat default threshold as exogeneous, but conceive it as given by face value of debt.
  - This identity arises naturally in more restrictive Merton (1974) model.
  - Moody's KMV imposes a slight variant.
- But this implies 100% recovery unless we appeal to
  - jumps in asset value process (Zhou 2001);
  - accounting uncertainty (Duffie & Lando 2001);
  - liquidation costs (Fan & Sundaresan 2000, Mella-Barral 1999);
  - asset specificities (Baird & Jackson 1988).

Asset-sale restrictions

- Debt contracts generally impose restrictions on "asset sales," e.g., proceeds must go to pay down debt.
  - Such restrictions needed to limit manipulation of leverage, as well as outright theft of assets.
- Leland (1994) and successors take strict view in which return on assets must stay in firm.
  - Coupon payments must be financed out-of-pocket by equity holders (or via new equity issuance).
  - Leads to "strategic default" literature, in which equity holders default when continuation value drops below required interest payments.
  - Default threshold endogeneously chosen by equity holders.

A looser interpretation

- Returns on V_t mostly in form of cashflows that are not subject to contractual restrictions.
  - Even firms in severe financial distress often have operating revenues sufficient to cover interest payments.
  - Deferred maintenance another way to draw down asset value.
- We make extreme assumption that asset-sale restrictions never bind on interest payment.
  - Keeps model tractable.
  - Contrast with existing literature.
- Implies equity holders never voluntarily default. Instead, need outside claimant to drag borrower to bankruptcy.
- Both stories can be observed in practice.

Loan covenants

- Loans have covenants that give the bank an option to call the loan when specified conditions are violated.
  - For pulling the plug on distressed firms, most important are financial covenants.
  - Highly customized to be observable, verifiable, and hard to manipulate.
- In a sample of 7990 syndicated loans, Carey (1996) found 65% had financial covenants. Of this subsample,
  - 63% had a leverage ratio test (e.g., total debt to total assets)
  - 62% had a coverage ratio test (e.g., operating income to interest expense)
  - 44% had a current ratio test (e.g., current assets to current liabilities)
- Carey finds likelihood of financial covenants
  - decreases with firm size;
  - increases with borrower default risk;
  - more likely with multi-lender loans.

Covenant waivers

- Covenants are typically tight.
  - Trigger ratios close to those reported at time of loan (Dichev & Skinner 2002; Chava & Roberts, 2006)
- In most cases, bank agrees to waive the violation
  - Not for free! Commonly involves fees paid to lender, increases in coupon rate, incorporation of additional covenants (Beneish & Press, 1993; Chava & Roberts, 2006).
  - In sample of distressed MBO, waiver granted in 2/3 of events, loan recall in only 14% (Citron & Wright, 2005).
  - Proxies for distance-to-default predict whether covenant violation resolved by waiver or recall (Chen & Wei, 1993).

Bond covenants

- Bond covenants far weaker.
  - Restrict financing, investment and restructuring activities (Nash, Netter & Poulsen 2003).
  - Only 4% of nonfinancial corporate bonds have a leverage covenant (Chava, Kumar & Warga 2004).
- We assume bond holders have no financial covenants.

Baseline model

- Black & Cox (1976) model for perpetual corporate debt with continuous coupons. Fixed capital structure.
    - Tractability: removes time-dependence in the value of debt.
    - Intuition: Putting microscope on "end game" for firm in distress. Maturity long relative to expected survival time.
- Riskfree rate fixed at r
- Single loan with face value λ and coupon $c > r$.
- Single bond with face value $1 - \lambda$ and coupon $\gamma > r$.
- Equityholders get continuous dividend $\delta + \rho V_t$.
- No restriction on asset sales for purpose of making these payments.
- Asset value (net of payments) follows GBM with variance σ^2.
  Under risk-neutral measure: $dV_t = V_t((r - \rho)dt + \sigma\, dZ_t) - \mathcal{C}dt$
  where $\mathcal{C} = c\lambda + \gamma(1 - \lambda) + \delta$ is rate of fixed cash outflows per unit time.

Loan value at bankruptcy

- Bankruptcy process is of known duration τ.
  From filing to emergence:
  - cashflows are frozen, V_t follows GBM;
  - bank's legal claim continues to accrue at rate c.
- Loan senior to bond.
- At time of filing, market value of loan is

$$B(V) = e^{-r\tau} \min\{e^{c\tau}\lambda, V_{t+\tau}\}$$

- Closed-form solution: Merton (1974) formula for value of defaultable zero-coupon debt with face value $e^{c\tau}\lambda$ and maturity τ.

Black-Cox formula for loan value

Assume default occurs at first-passage of V_t across known threshold κ. For asset value $V \geq \kappa$, loan value is given by

$$F(V;\kappa) = \lambda\frac{c}{r} - \left(\lambda\frac{c}{r} - B(\kappa)\right) \cdot \frac{\psi(V;\alpha,\beta,\zeta)}{\psi(\kappa;\alpha,\beta,\zeta)}$$

where

$$\begin{aligned}
\psi(V;a,b,\zeta) &= (\zeta V)^{-a} \cdot {}_1F_1\left(a, a+b, -1/(\zeta V)\right) \\
\alpha &= \sqrt{\left(\frac{1}{2} - \frac{r-\rho}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} - \left(\frac{1}{2} - \frac{r-\rho}{\sigma^2}\right) \geq \frac{2(r-\rho)}{\sigma^2} > 0 \\
\beta &= \alpha + 2 - \frac{2(r-\rho)}{\sigma^2} \geq 2 \\
\zeta &= \frac{\sigma^2}{2}\frac{1}{\mathcal{C}}
\end{aligned}$$

Endogeneous foreclosure threshold

- Assume loan covenants allow bank to foreclose at will. Bonds have no covenants.
- At optimal κ, bank is indifferent between foreclosure and forbearance, so κ^* solves

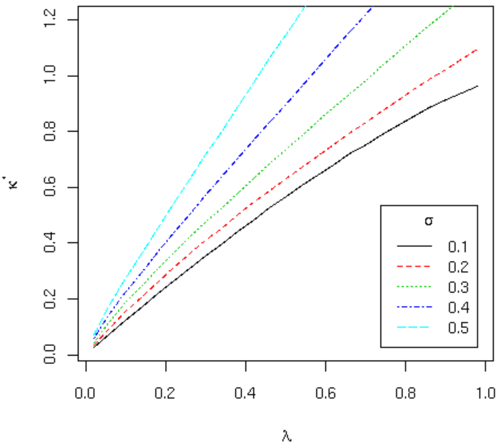
$$\mathcal{F}(\kappa) \equiv \left.\frac{\partial F(V;\kappa)}{\partial \kappa}\right|_{V=\kappa} = 0$$

- FOC has tractable analytical expression, but numerical solution needed in general.
  - Analytical solutions for special cases $\sigma = 0$ and $\sigma \to \infty$,
  - Solution $\kappa^* > 0$ always exists, appears to be unique.

Comparative statics for foreclosure threshold

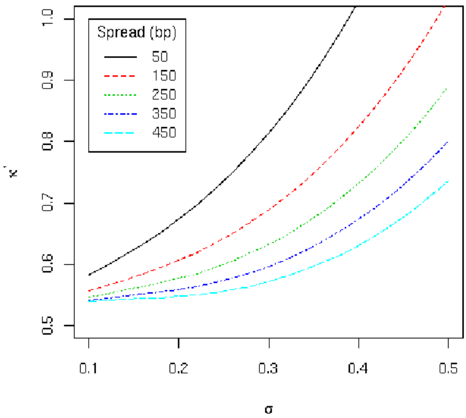
- Intuition suggests κ^* should increase with λ.
  - In non-stochastic limit, bank forecloses at PDV of the legal claim at emergence,
  $$\lim_{\sigma \to 0} \kappa^* = \lambda \cdot \exp(\tau(c - r))$$
  - Can also get analytic solution for $\sigma \to \infty$, find again that $\kappa^* \propto \lambda$.
  - Conjecture that κ^* is always increasing with λ, perhaps close to linear.
- Intuition suggests κ^* should increase with σ.
  - all else equal, higher σ reduces post-default market value of the senior debt;
  - so the bank should foreclose earlier to protect its recovery.
- Intuition suggests κ^* should decrease with c.
  - all else equal, higher c increases the value of the cash stream from the loan (relative to value obtained by foreclosing);
  - so the bank should be more willing to forbear.

Effect of loan share on foreclosure threshold



Parameters: $r = 0.05$, $c = 0.07$, $\gamma = 0.08$, $\delta = \rho = 0$, $\tau = 1$.

Effect of coupon and volatility on foreclosure threshold

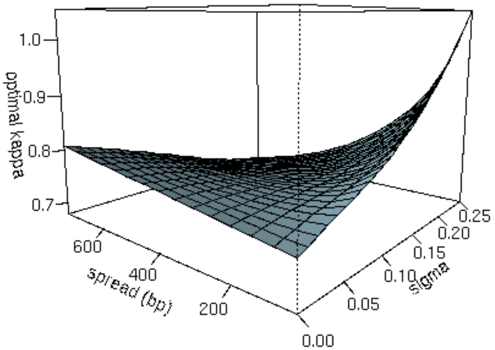


Spread is $c - r$, measured in basis points.

Parameters: $r = 0.05$, $\lambda = 0.5$, $\gamma = 0.08$, $\delta = \rho = 0$, $\tau = 1$.

A pathological corner of the parameter space

Comparative statics for κ^* wrt σ and c reversed when σ very low, c very high.



Spread is $c - r$. Parameters: $r = 0.05$, $\lambda = 0.75$, $\gamma = 0.08$, $\delta = \rho = 0$, $\tau = 1$.

Recovery at emergence

In equilibrium, expected recovery at emergence will be

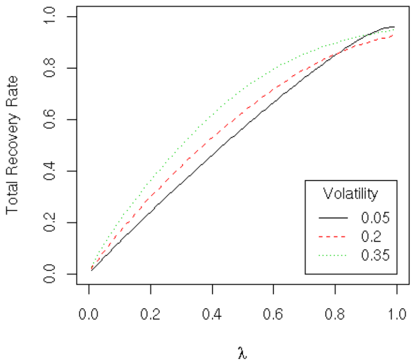
$$
\begin{aligned}
R^e &= \frac{\exp(\tau\mu)B(\kappa^*; \lambda\exp(\tau c) + (1-\lambda), \sigma, \mu, \tau)}{\lambda\exp(\tau c) + (1-\lambda)} \\
R^e_\ell &= \frac{\exp(\tau\mu)B(\kappa^*; \lambda\exp(\tau c), \sigma, \mu, \tau)}{\lambda\exp(\tau c)} \\
R^e_b &= R^e - (R^e_\ell - R^e)\frac{\lambda\exp(\tau c)}{1-\lambda}
\end{aligned}
$$

where μ is drift for V under physical measure.

Comparative statics for recovery

- Intuition is that total recovery should increase with λ and σ, decrease with c.
- But loan recovery R_ℓ^e may decrease with λ and σ.
- Problem is spillovers: some of the benefit to tightening foreclosure policy is captured by bondholders, not the bank.
- The higher the loan's recovery rate, the greater the spillover.

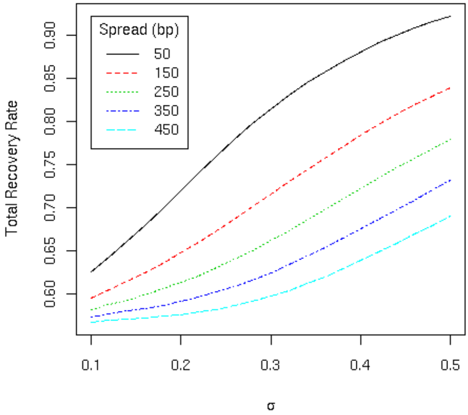
Effect of bank debt share on total recovery



Recovery rates at emergence. Spread is $c - r$, measured in basis points.

Parameters: $r = 0.05$, $\mu = 0.10$, $c = 0.07$, $\gamma = 0.08$, $\delta = \rho = 0$, $\tau = 1$.

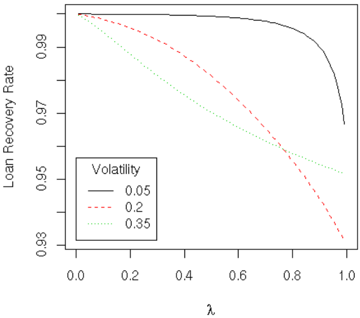
Effect of coupon and volatility on total recovery

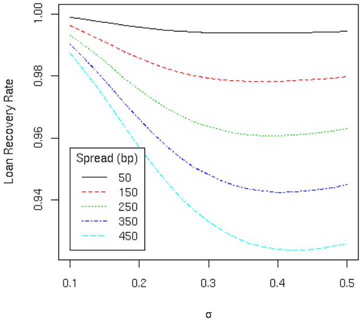


Recovery rates at emergence. Spread is $c - r$, measured in basis points.

Parameters: $r = 0.05$, $\mu = 0.10$, $\lambda = 0.5$, $\gamma = 0.08$, $\delta = \rho = 0$, $\tau = 1$.

Comparative statics for loan recovery





Recovery rates at emergence. Spread is $c - r$, measured in basis points.

Parameters: $r = 5\%$, $\mu = 10\%$, $\lambda = 50\%$ (right), $c = 7\%$ (left), $\gamma = 8\%$, $\delta = \rho = 0$, $\tau = 1$.

Extension: Stochastic bankruptcy cost

- Event of foreclosure can impart a shock to asset value.
  - legal costs associated with bankruptcy;
  - loss of franchise value;
  - certain contracts might be invalidated at foreclosure.
- In some cases, invalidation of contracts can be beneficial to firm value, e.g.,
  - renegotiation of crippling labor contract;
  - shedding of pension liabilities.
- Model bankruptcy costs as a multiplicative shock to V_t, realized immediately upon foreclosure. Shock is logNormal(χ, η^2).
  - Generalizes fixed proportional bankruptcy cost in Leland (1994).
  - Effect on bank behavior is through its effect on recovery value, given by generalization of Merton's formula.
- Find loan and bond recoveries fall as χ more negative and as η increases.

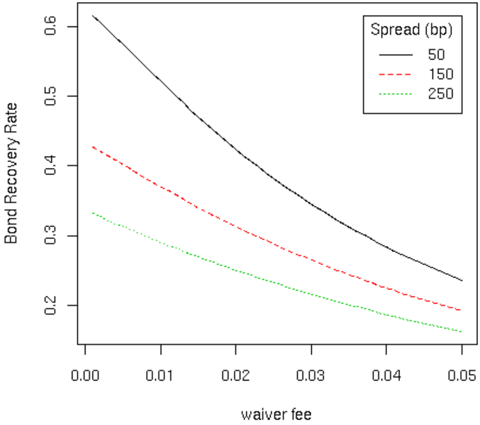
Extension: Covenant boundary and waiver

- In reality, covenants empower banks to foreclose only when the borrower is in distress.
- We introduce a covenant boundary ν. When $V > \nu$, the bank cannot foreclose.
- When $V \leq \nu$, the bank can either foreclose or waive its covenant rights.
- In case of waiver, a waiver penalty of w is added to the coupon.
- Model yields separate differential equations for $V \leq \nu$, $V > \nu$. Apply smooth pasting condition at $V = \nu$.

Waiver fee as a bribe

- Waiver fee buys forbearance. Raising w lowers κ^*.
- Except in pathological corner:
  - When σ is very low and λ is near one, the effect is reversed.
  - This case won't arise in practice. Why include waiver fees in a loan contract when these parameter values pertain?
- Recoveries on loan and on bond fall as w increases,
  - Waiver fee of 4% halves bond recovery.

Effect of waiver fee on bond recovery



Recovery at emergence. Spread is $c - r$. Parameters: $r = 0.05$, $\sigma = 0.3$, $\lambda = 0.5$, $c = 0.07$, $\gamma = 0.08$, $\delta = \rho = 0$, $\chi = \eta = 0$, $\tau = 1$, $\nu = 1$.

Empirical predictions

- Firm-level recovery rate is strongly increasing with bank debt share of firm's total debt.
  - Strict interpretation of model suggests roughly one-for-one relationship.
  - If default is sometimes strategic action of equityholders, then relationship will be attenuated.
- Firm-level recovery rate is decreasing with loan spread.
  - Strategic default models give opposite prediction.
- Firm-level recovery rate is typically increasing with asset volatility.
  - Unfortunately, no good data on σ, as our model implies that Moody's KMV measure is misspecified and that the error is correlated with λ.
- Firm-level recovery rates should vary a lot and on average be far below 100%.
- Bank debt recovery should usually be very high.
  - Median is 97% in our data.

Data

- S&P LossStat database on US bankruptcies
  - Compiled from SEC filings and bankruptcy court documents.
  - Medium-sized to large corporates.
  - S&P attempts to capture all defaults by firms with at least $50 million of debt outstanding on default date.
  - Missing some claims, in particular trade credit and legal fees.
- Data starts in 1987, relatively sparse in early years.
- We omit bankruptcies after 2004 to avoid censoring.
- 644 observations, 360 when matched to Compustat.
- Mean firm-level recovery is 48%.

Regression results

Independent Variable	(1) Base case Coeff.	(1) Base case p-value	(2) Compustat subsample Coeff.	(2) Compustat subsample p-value	(3) Add interest rate Coeff.	(3) Add interest rate p-value
Intercept	58.76	<.001	64.67	<.001	72.63	<.001
Share bank debt	**24.43**	0.000	**27.88**	0.002	**27.30**	0.003
No bank debt dummy	-3.45	0.431	3.84	0.523	n.a.	n.a.
All bank debt dummy	10.13	0.091	16.53	0.037	6.19	0.376
Share secured debt	-2.29	0.588	-9.26	0.113	-5.77	0.388
All sub debt dummy	-10.44	0.104	-20.91	0.008	n.a.	n.a.
No sub debt dummy	2.50	0.528	5.70	0.234	5.29	0.350
Share sub debt	-10.63	0.112	-8.12	0.312	-7.12	0.491
Loan interest rate spread					**-2.72**	0.038
Time in bankruptcy	0.34	0.822	-1.51	0.415	-0.21	0.922
Time from plan to emerge	-5.02	0.062	1.64	0.643	-11.01	0.019
Time in default pre-filing	-0.38	0.874	3.79	0.297	-1.72	0.666
Prepackaged bankruptcy	5.84	0.043	4.91	0.180	2.23	0.575
Bubble-firm dummy	-16.56	0.007	-9.91	0.166	-24.34	0.006
Selected industry dummies:						
Utilities	26.41	0.001	19.58	0.067	14.46	0.156
Telecom	-5.58	0.352	-17.65	0.016	-5.55	0.500
Computer	-4.40	0.342	-11.71	0.044	-4.99	0.454
Airline	-7.62	0.398	-22.44	0.029	-8.51	0.651
Bankruptcy year dummies?	yes		yes		yes	
Court dummies?	yes		yes		yes	
Accounting variables?	no		yes		no	
Number observations	644		360		343	
Adjusted R-squared	**0.27**		**0.38**		**0.25**	

Summary of empirical findings

- Effect of bank debt share large, highly significant, robust.
  - Going from no bank debt to all bank debt increases expected recovery by $\approx$ 35–40 percentage points.
- Recovery falls with share of sub debt. Effect is strong, but less robust.
- Higher share secured debt appears to have no effect.
- Consistent with model, firm-level recovery falls with loan spread.
- Time in bankruptcy does not matter, consistent with Covitz, Han & Wilson (2004). But proxies for bargaining frictions do matter.
  - Time from plan filing to emergence has negative effect.
  - Dummy for pre-packaged bankruptcies positive, sometimes significant.
- Utilities have higher recoveries, "bubble firms" lower.
- Book leverage ratio has small significant effect.
  - No significant effect for firm size, tangibility of assets, agency rating, pre-default cash flow.
- Results robust to Tobit specification.

Implications

- Our empirical findings support the view that banks play a crucial role in forcing insolvent borrowers into bankruptcy. Early foreclosure on such borrowers preserves asset-value available to creditors.
- Conventional analysis of instrument-level recovery by seniority is misspecified.
  - Seniority "label" a crude proxy for an instrument's place in debt structure.
  - Incorporating loan share in estimating expected recovery would improve performance of pricing and risk management models.
- Recent work on recoveries has focused on role of systematic risk.
- Our results suggest loan share has a much larger role.
  - Preliminary results suggest measured systematic effect may actually be due to composition effects (cyclical variation in bond issuance).