REEXAMINING THE EMPIRICAL RELATION BETWEEN LOAN RISK AND COLLATERAL: THE ROLES OF COLLATERAL CHARACTERISTICS AND TYPES

Allen N. Berger
University of South Carolina
Wharton Financial Institutions Center
CentER, Tilburg University

W. Scott Frame*
Federal Reserve Bank of Atlanta

Vasso Ioannidou
CentER, Tilburg University

BACKGROUND

- **Collateral is a prominent feature of debt contracts around the world.**

- **In the wake of the recent financial crisis, it is clear that there were significant losses on collateralized loans and that declines in the value of widely pledged assets can amplify the business cycle through procyclical changes in credit availability.**
  - **E.g., Bernanke and Gertler (1989, 1990); Kiyatoki and Moore (1997); and Gan (2007).**

- **These events suggest that certain types of secured credit may be associated with high risk.**

- **However, the empirical literature on the association between collateral and risk is mixed, with implications for the underlying motivation for collateral pledges.**

BACKGROUND (Cont.)

- **Economic theory generally explains collateral as an attempt to reduce agency costs or contracting frictions in the presence of asymmetric information.**

- **One set of theories motivates collateral as part of an optimal debt contract by invoking *ex post* frictions, such as moral hazard.**
  - **E.g., Boot, Thakor, and Udell, 1991; Boot and Thakor, 1994; Aghion and Bolton, 1997; and Holmstrom and Tirole, 1997.**

- **A second set of theories focuses on *ex ante* private information.**
  - **E.g., Bester, 1985, 1987; Besanko and Thakor, 1987a, 1987b; Chan and Thakor, 1987; and Boot, Thakor, and Udell, 1991.**

FOUR RISK-COLLATERAL CHANNELS

- The two sets of collateral theories imply four distinct channels through which loan risk and collateral may be related.

- "Lender selection" effect – observably riskier borrowers are required to pledge collateral under *ex post* theories of collateral to reduce moral hazard and other *ex post* frictions.

- "Borrower selection" effect – unobservably safer borrowers tend to pledge collateral more often to signal their underlying quality under *ex ante* theories of collateral.

- "Risk shifting" effect – secured borrowers are encouraged to shift into safer investment projects under both sets of theories.

- "Loss mitigation" effect – collateral reduces losses in the event of borrower default under both sets of theories, as the lender is able to recover value from the pledged assets.

- In our empirical analysis, we attempt to isolate the four individual effects of collateral on loan risk to the extent possible.

4

MAIN EMPIRICAL LITERATURE

- **Empirical studies linking risk and collateral find mixed results.**

- **Relation between loan risk premiums and collateral.**

    - **Positive relation: Berger and Udell, 1990; Blackwell and Winters, 1997; Machauer and Weber, 1998; John, Lynch, and Puri, 2003; Brick and Palia, 2007; Godlewski and Weill, 2011.**

    - **Negative relation: Degryse and Van Cayseele, 2000; Lehmann and Neuberger, 2001; Agarwal and Hauswald, 2010; Berger, Frame, and Ioannidou, 2011.**

    - **No relation: Berger and Udell, 1995.**

- **Relation between *ex post* nonperformance of loans (delinquency or default) and collateral.**

    - **Positive relation: Jimenez and Saurina, 2004; Berger, Frame, and Ioannidou, 2011.**

PUZZLE AND POSSIBLE SOLUTION

- **Puzzle: Why is the relation between loan risk and collateral sometimes positive and sometimes negative?**

- **This paper provides a potential solution to this puzzle by examining the relations between loan risk and different economic characteristics of collateral and different collateral types.**

- **Different economic characteristics and types of collateral may be associated with the empirical dominance of different risk-collateral channels.**
  - **We find support for this conjecture.**

- **Suggests that the prior literature may have conflicting results because the different samples may be dominated by collateral with different economic characteristics or different collateral types.**

RESEARCH INNOVATIONS

- **First to identify and attempt to explain the risk-collateral puzzle.**

- **First to identify the four risk-collateral channels implied by extant theories and evaluate the extent to which each is effective in the data.**

- **First to map collateral into three different economic characteristics (liquidity, divertibility, and ownership status).**

- **First to evaluate how a variety of economic characteristics of collateral and collateral types are associated with loan risk.**

  - **Some research has looked at a single economic characteristic or type of collateral: Berger and Udell, 1995; John, Lynch, and Puri 2003; Voordeckers and Steijvers, 2006; Brick and Palia, 2007; Benmelech, Germaise, and Moskowitz, 2005; Benmelech and Bergman, 2008, 2009, 2011.**
  - **None attempts to address the empirical puzzle or the extent to which the four risk-collateral channels are effective.**

PREVIEW OF MAIN RESULTS

- **We find evidence supporting the economic importance of each of the four risk-collateral channels.**

  – **For our sample, collateral overall is associated with reduced loan risk premiums and higher rates of *ex post* nonperformance.**
    - **This suggests that the dominant reason why collateral is pledged is the "lender selection" effect, while the primary reason that collateralized loans carry lower risk premiums is the "loss mitigation" effect.**

  – **The risk-collateral channels appear to depend upon the economic characteristics and types of collateral.**
    - **Characteristics. The "lender selection" effect appears to be especially important for outside collateral, the "risk-shifting" and/or "loss mitigation" effects for liquid collateral, and the "borrower selection" effect for nondivertible collateral.**
    - **Types. The "lender selection" effect is particularly strong for residential real estate collateral and that the "risk shifting" effect is important for pledged deposits and bank guarantees.**

DATA

- **Bolivian Credit Registry**
  - **The Bolivian Superintendent of Bank and Financial Entities requires all licensed and regulated financial institutions in Bolivia to report information about all loans.**

- **Available Information**
  - <u>**Loan:**</u> **origination date, maturity date, loan contract terms (including collateral type and interest rate), and *ex post* performance;**
  - <u>**Firm:**</u> **industry, physical location, legal structure, banking relationships, and prior loan performance;**
  - <u>**Lender:**</u> **lender name, lender type, etc.**

- **Sample: Commercial loans originated between March 1998 and December 2003**
  - **13 commercial banks;**
  - **"Standard debt contracts": installment & single payment loans (92%);**
  - **Only loans denominated in US dollars (98%);**
  - **Excludes draws on lines of credit, loan renegotiations, and loans backed by multiple collateral types.**
  - **Total of 28,252 loans to 2,470 different firms.**

KEY VARIABLES & SUMMARY STATISTICS

Variable	NOBS	Mean
Dependent variables:		
Risk_Premium	**28,252**	**9.507**
Ex_Post_Nonperformance	**25,918**	**0.059**
Key Exogenous Variables:		
Collateral	**28,252**	**0.177**
Collateral Types (When Collateral = 1):		
Pledged Deposits	**4,989**	**0.091**
Bank Guarantees	**4,989**	**0.037**
Securities	**4,989**	**0.022**
Creditor-Held Movable Assets	**4,989**	**0.158**
Debtor-Held Movable Assets	**4,989**	**0.248**
Residential Real Estate	**4,989**	**0.199**
Commercial Real Estate	**4,989**	**0.088**
Collateral Bonds	**4,989**	**0.135**
Vehicles	**4,989**	**0.023**

ECONOMIC CHARACTERISTICS OF COLLATERAL

- **Liquidity.**
  - Collateral is considered to be *Liquid* if the pledged asset can be converted into cash quickly without substantial discount on its price.
  - Example: securities are considered liquid.

- **Divertibility.**
  - Collateral is called *Nondivertible* if the firm cannot divert an asset to an alternative use or reduce maintenance.
  - Example: creditor-held movable assets are considered nondivertible.

- **Ownership Status.**
  - Collateral is considered to be *Outside* if the pledged asset would not otherwise be legally attachable in the event of default.
  - Example: residential real estate pledged by a limited liability company is considered outside.

- We use simple (0,1) dummy variables to define the types of collateral that satisfy these characteristics.

MAPPING FROM COLLATERAL TYPES TO ECONOMIC CHARACTERISTICS

Type of Collateral	Liquid	Nondivertible	Outside
Pledged Deposits	1	1	0
Bank Guarantees	1	1	1
Securities	1	1	0
Creditor-Held Movable Assets	0	1	0
Debtor-Held Movable Assets	0	0	0
Residential Real Estate_LL_Firms	0	0	1
Residential Real Estate_Non_LL_Firms	0	0	0
Commercial Real Estate	0	0	0
Collateral Bonds	0	1	0
Vehicles	0	0	0
Percentage of Secured Loans	14.3%	44.2%	14.7%

EMPIRICAL APPROACH

- Empirical tests for two different measures of loan risk, *Risk_Premium* and *Ex_Post_Nonperformance*.

- *Risk_Premium* = loan interest rate less US Treasury rate of comparable maturity for the month of loan origination.

Regression Equations

- $Risk\_Premium_{ijkt} = a(Collateral_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t)$

- $Risk\_Premium_{ijkt} = b(Collateral_{ijkt}, Collateral\ Characteristics_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t)$

- $Risk\_Premium_{ijkt} = c(Collateral\ Types_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t)$

- *Collateral* = 1 if collateral is pledged, = 0 otherwise.
- *Collateral Characteristics* = vector of dummies for three collateral characteristics (*Liquid, Nondivertible, Outside*).
- *Collateral Types* = vector of dummies for nine collateral types.
- Equations include firm, relationship, and loan variables and fixed effects for region, bank, time, and industry (and sometimes interactions of firm, bank, and time fixed effects).
- Estimated using OLS. Standard errors corrected for heteroskedasticity.

EMPIRICAL APPROACH

- *Ex_Post_Nonperformance* = 1 if loan is 30+ days overdue or if downgraded to default status, = 0 otherwise.

Regression Equations

- $Ex\_Post\_Nonperformance_{ijkt} = d(Collateral_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t)$

- $Ex\_Post\_Nonperformance_{ijkt} = e(Collateral_{ijkt}, Collateral\ Characteristics_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t)$

- $Ex\_Post\_Nonperformance_{ijkt} = f(Collateral\ Types_{ijkt}, Firm_{jt}, Relationship_{jkt}, Loan_{ijkt}, Bank_k, Industry_l, Region_m, Time_t)$

- The same control variables are included – except for the interaction of firm, bank, and time fixed effects because of few repeated nonperformance observations for individual firms.

- Estimated using probit. Standard errors corrected for heteroskedasticity.

RESULTS: *RISK_PREMIUM* FOR COLLATERAL AS A WHOLE

Variable	(1)	(2)	(3)
Collateral	-0.600***	-0.580***	-0.636***
Firm Characteristics		Yes	
Relationship Characteristic		Yes	
Loan Characteristic (Installment)	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	
Bank Fixed Effects	Yes	Yes	
Time (Month-Year) Fixed Effects	Yes	Yes	
Industry Fixed Effects		Yes	
Firm*Bank*Time Fixed Effects			Yes
Adjusted R-Squared	0.35	0.41	0.87
Number of Observations	28,252	28,252	13,274

- Column (1) suggests that collateral overall is associated with a 60 basis point discount. This is consistent with the empirical domination of the combination of the "borrower selection," "risk shifting," and "loss mitigation" effects over the "lender selection" effect.
- As we move from (1) to (3), we control for more firm characteristics which reduces the "lender selection" and "borrower selection" effects.
    - (3) is primarily determined by multiple loans to the same firm by the same bank in the same month – virtually eliminates "lender selection" and "borrower selection" effects.
- Negative coefficient virtually unchanged from (1) to (3) -- indicates that the "risk shifting" and/or "loss mitigation" effects empirically dominate.

RESULTS: *EX_POST_NONPERFORMANCE* FOR COLLATERAL AS A WHOLE

Variable	(1)	(2)
Collateral	0.035***	0.028***
Firm Characteristics		Yes
Relationship Characteristic		Yes
Loan Characteristic (Installment)	Yes	Yes
Region Fixed Effects	Yes	Yes
Bank Fixed Effects	Yes	Yes
Time (Month-Year) Fixed Effects	Yes	Yes
Industry Fixed Effects		Yes
Pseudo R-Squared	0.09	0.15
Number of Observations	25,391	25,380

- Reminder – column (3) with the interaction of firm, bank, and time fixed effects is excluded because of few repeated nonperformance observations for individual firms.

- *Ex_Post_Nonperformance* excludes the "loss mitigation" effect.

- Positive relation with collateral suggests that the "lender selection" effect empirically dominates the "borrower selection" and "risk shifting" effects.

- When combined with the loan risk premium results, suggests that the dominant reason that collateral is pledged is the "lender selection" effect, while the lower risk premiums arise primarily because of the "loss mitigation" effect.

RESULTS: *RISK_PREMIUM* FOR COLLATERAL CHARACTERISTICS

Variable	(1)	(2)	(3)
Collateral	-0.413***	-0.431***	-0.466***
Liquid	-1.197***	-1.199***	-0.517**
Nondivertible	-0.242***	-0.165**	-0.160
Outside	1.073***	1.075***	-0.086
Firm Characteristics		Yes	
Relationship Characteristic		Yes	
Loan Characteristic (Installment)	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	
Bank Fixed Effects	Yes	Yes	
Time (Month-Year) Fixed Effects	Yes	Yes	
Industry Fixed Effects		Yes	
Firm*Bank*Time Fixed Effects			Yes
Adjusted R-Squared	0.36	0.42	0.87

- Looking at (1) and (2), we find very different effects on the loan risk premium for each of the economic characteristics, justifying our separate treatment.
- The negative and statistically significant coefficient for *Liquid* collateral in all three specifications is consistent with substantial "risk shifting" and/or "loss mitigation" effects for liquid collateral.
- The finding that the coefficient for *Nondivertible* is negative in (1) and (2) and statistically insignificant in (3) is consistent with a dominant "borrower selection" effect for this characteristic.
- In (1) and (2), the positive overall effect of outside collateral is consistent with a strong "lender selection" effect, suggesting that the riskiest firms are often required to pledge outside collateral. This is confirmed by (3), where the "lender selection" and "borrower selection" effects are virtually eliminated.

RESULTS: *EX_POST_NONPERFORMANCE* FOR COLLATERAL CHARACTERISTICS

Variable	(1)	(2)
Collateral	0.056***	0.049***
Liquid	-0.033***	-0.024***
Nondivertible	-0.023***	-0.025***
Outside	0.020*	0.019*
Firm Characteristics		Yes
Relationship Characteristic		Yes
Loan Characteristic (Installment)	Yes	Yes
Region Fixed Effects	Yes	Yes
Bank Fixed Effects	Yes	Yes
Time (Month-Year) Fixed Effects	Yes	Yes
Industry Fixed Effects		Yes
Pseudo R-Squared	0.10	0.16

- The statistical significance of the economic characteristics again justifies their inclusion.

- The positive coefficient on collateral as a whole and the joint positive effects of *Liquid*, *Nondivertible*, and *Outside* collateral (with collateral overall) suggest the presence of a "lender selection" effect for all kinds of collateral.

CONCLUSIONS

- **A puzzle in the empirical literature is that loan risk and collateral are found to sometimes be positively related and sometimes negatively related.**

- **This paper offers a potential solution to this puzzle by showing that different risk-collateral channels are effective to different degrees for collateral with different economic characteristics and different collateral types.**

  - **Thus, the puzzle may be explained by the possibility that different studies use data samples with different mixes of collateral characteristics and types.**