Collateral Value and Financial Constraint: Analysis using Corporate Data after the Tohoku Earthquake

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Empirical question in this paper

Loss in the value of collateral

→ **reduction in firms' financing?**

(through reduced debt capacity)

Test of the so-called

"**collateral channel**"

MOTIVATION AND BACKGROUND

Motivation and Background

- **Theoretical prediction**
  - **Debt capacity**
    - Borrowers obtain rents under moral hazard problems
      - As incentives to take efficient actions (e.g. Holmström and Tirole 1998)
    - Borrowers cannot commit to making repayment using the entire project returns
      - Due to contractual incompleteness (e.g. Hart and Moore 1998)

    → Compensation to lenders limited by reduced rents/pledgeable income

    → Lend only up to some amount (<--- **debt capacity**)

Motivation and Background

- **Theoretical prediction**
  - **Collateral** increases **debt capacity**
    - Collateral (together with other contract terms) may provide greater incentives to borrowers
    - Collateral directly increases the pledgeable income
  - → **Collateral channel**
    - "Decline in asset prices → reduced collateral value → smaller debt capacity → reduced investment and output → more decline in real economy → ... "
      - (Bernanke and Gertler 1989, Kiyotaki and Moore 1997)

This paper

- **Aim of this paper**
  - Empirically examine whether the **collateral channel** exists
    - By examining the relation between
      - Firms' real estate value
      - and Firms' financing

Preview of the findings

- **Main findings in this paper**
  - Loss in the value of real estate → reduced probability of obtaining loans
    - Both for the value loss in land and in non-land real estate
    - But the effect of land value loss more significant
  - This effect greater for firms with more (pre-earthquake) leverage
    - more leverage ←→ smaller (remaining) debt capacity

--- consistent with the **collateral channel**

Literature and Contribution

- **Existing studies on the collateral channel**
  - Gan (2007a)
    - Collapse of asset price bubble in Japan (early 1990s) → reduced borrowing/investment
  - Chaney, Sraer, and Thesmar (2012)
    - Surge in real estate prices in US (-2007) → more debt and investment
  - Cvijanović (2014)
    - Surge in real estate prices in US → more leverage, more public debt, more long-term debt, reduced costs of financing, smaller number of covenants
  - Adelino, Schoar, and Severino (2014)
    - States with more surge in housing prices in US → more start-ups and employments

This paper

- **Empirical challenges: Identification**
  - Relation between real estate value and financing may stem from factors other than the collateral channel
- **How to identify** the collateral channel?
  - Existing studies: Instruments, controls
    - (see below)
  - **Our** study: Natural experiment
    - Using unique data from a corporate survey (direct info on the loss in asset value, fund-raising)
    - Examine
      - Damage to firms' assets due to **Tohoku Earthquake** (2011.3.11)
        - Pure **exogeneous shock**
      - → difficulty in fund raising afterwards?

Literature and Contribution

- **Possible endogeneity considered in existing studies**
  - A) Correlation between real estate **prices** and firms' investment opportunities
    - Examples
      1. Large firms may have non-negligible impacts on the local economy
         → investment by large firms (holding more real estate) increases real estate prices
      2. Real estate prices may proxy for local demand shocks, and firms holding more real estate may be more sensitive to local demand
      3. Improvement in local economy increases real estate values
      4. ...

- **Resolution in existing studies: Instrumental variable**
  - Instrument real estate prices by the elasticity of local real estate supply (Saiz 2010)

Literature and Contribution

- **Possible endogeneity considered in the existing studies**
  - B) Correlation between real estate **holdings** and firms' investment opportunities
    - Examples
      1. Land holdings firms found to have smaller growth opportunities → smaller investment
      2. Land holding firms more sensitive to local demand shock (and so their investment more sensitive to changes in real estate values)
      3. Firms with more informational asymmetry more likely to borrow from banks and do not use leases
      4. ...

- **Resolution in the existing studies: Control variables**
  - Use ex ante firm characteristics as controls

Literature and Contribution

- **Possible endogeneity considered in the existing studies**
  - A) Correlation between real estate **prices** and firms' investment opportunities
  - B) Correlation between real estate **holdings** and firms' investment opportunities
- **Fundamental cause of possible endogeneity**
  - Use of estimated, and realized (equilibrium), values of real estate
    - Equilibrium values (prices) determined by various factors
      - → never be an exogenous shock
    - Estimated values using past book values multiplied by price changes afterwards
    - Estimated values using local (not firm-level) price indices
      - → Imprecise measurement of the value
      - → Proxy for local shocks
- **In our paper**
  - Directly use changes in real estate values (from the survey)
    - Firm-level information
    - (may suffer from mistakes and subjectivity bias)

Literature and Contribution

- **Yet another possible endogeneity in the existing studies**
  - C) Lending channel
    - "Real estate shocks to **lending banks** → reduced lending capacity → smaller loans"
      - "Smaller (larger) value of firms' real estate → smaller (larger) fund-raising"
        - may capture this channel to the extent that "Smaller (larger) value of firms' real estate" capture "Smaller (larger) value of banks' real estate"
      - Worried especially because of the use of local real estate prices
  - **Resolution in the existing studies: Control variables**
    - Use bank level controls (in Gan 2007a only)
  - **In our paper**
    - Use changes in real estate values (survey-info)
      - Firm-level direct information
    - AND use proxies for bank damages as well

DATA AND METHODOLOGY

Data and methodology

- Source
  - 「震災復興企業実態調査」(Survey on firms rehabilitating from the earthquake)
    - Conducted by 東北大学大学院経済学研究科震災復興研究センター (Research Center for the Rehabilitation from the Earthquake, Graduate School of Economics, Tohoku University)
    - Target firms: 30,000 firms
      - Those compiled in the database of Tokyo Shoko Research ltd.
        - One of the largest credit information providers in Japan
      - Those located in 3 prefectures (Iwate, Miyagi and Fukushima) and 1 city (Hachinohe City of Aomori pref.) in Tohoku
      - Those proportionally selected based on firm size and location (coastal vs. inland areas)
    - Responses
      - 7,021 firms (23.4%)

Data and methodology

- Sample selection from the 7,021 firms
  - Firms with complete information for the variables we use
  - Firms who had demand for funds (based on survey)
  - Firms that do not receive the Group Subsidy by the government
    - To exclude bridge financing until receiving the subsidy
  - → 1,392 firms

Data and methodology

- Regression (probit)

$$\Pr[\text{Loan\_accept}_i = 1] = \Pr[y_i^* > 0],$$

where

$$y_i^* = X_i\, b + e_i$$

  - i =1, …, N: firms
  - Loan_accept: indicator of firm obtaining new borrowing
    - Sample includes firms with loan demand only
  - y_i^* : latent variable to determine the probability of exit
  - X_i : vector of independent variables
    - Details of the variables: see below
  - e_i : ordinary error term
- Description of the variables
  - Table 1: descriptive statistics
    - Loan_accept: =1 for 91.8% of the firms

Methodology

- **Main independent variables**
  - **Measure for the loss in real estate value: Asset_damage**
    - **Definition**: 3 alternative variables as Asset_damage
      1. Land_value_loss: Damages in land values (evaluation loss) / Total asset
      2. Nonland_value_loss: Damages in values of non-land real estate (replacement costs) / Total asset
      3. Asset_value_loss: Land_value_loss + Nonland_value_loss
      - Also use a specification using both Land_value_loss and Nonland_value_loss
    - Descriptive stats:
      - Land_value_loss: Mean 1.1%, Max 72.5% (**Table 1**)
        - many firms with Land_value_loss =0
        - small number of firms suffering from a large damage
      - Nonland_value_loss: Mean 10.3%, Max: 4.29% (**Table 1**)
        - larger number of firms reporting losses in nonland assets

Methodology

- **Control variables (1)**
  - **Firm_damage (dummy)**
    - Any direct damage from the earthquake (based on survey response)
    - =1 for 69.8% of the firms (**Table 1**)
  - **Bank_damage (dummy)**
    - Damages to the top lender (with largest amount of loans before the earthquake)
      - Yes to "*the lender's transacting branch could not (or does not) operate due to the earthquake/tsunamis/nuclear accident*"
      - or to "*there was a change in the transacting branches after the earthquake/tsunamis/nuclear accident*"
    - =1 for 11% of the firms (**Table 1**)

Methodology

- **Control variables (2)**
  - **Debt_reduction_main (dummy)**
  - **Debt_reduction_nonmain (dummy)**
    - Obtained debt reduction from the top or non-top lender(s)
      - in the form of "*suspension of repayment*", "*extension of the repayment period*", "*reduction in interest rates*", "r*eduction in the amount of debt*", "*removal or reduction of collateral/guarantee*" or "*subordination of existing borrowing*"
    - =1 for (resp.) 20% (top) and 13.5% (non-top) of the firms (Table 1)
  - **Loan_purchase (dummy)**
    - Third-party purchase of existing debt
    - =1 for 4.1% of the firms (**Table 1**)

Methodology

- **Control variables (3)**
  - **Supplier_damage / Customer_damage (dummy)**
    - Suffered from indirect damage from the damage to suppliers/customers
  - **Support_group_firm、Support_partners、Support_rivals、Support_industry_group、Support_abroad、Support_municipals1、Support_municipals2、Support_municipals3 (dummy)**
    - Aids/supports from different parties
  - **Nuclear_compensation (dummy)**
    - Amount of compensation for the damages from the Fukushima nuclear accident (/ total asset)
  - **Insurance (dummy)**
    - Amount of insurance for the damages from the earthquake (/ total asset)

Methodology

- **Control variables (4)**
  - **Business_condition (multinomial)**
    - Pre-earthquake performance of the firms
  - **Ln(Capitalization)**
    - Log (paid-in capital)
  - **D_high_leverage (dummy)**
    - High leverage firms: Leverage > median
  - **D_single_bank (dummy)**
    - Firms transacting with a single bank
  - **D_damaged_area, D_tsunami_area, D_nuclear_area (dummy)**
    - Location in cities and towns
      - included in the Japanese Government's Act Concerning Special Financial Support to Deal with a Designated Disaster of Extreme Severity (激甚災害法)
      - Flooded
      - Affected by the Fukushima nuclear accident

RESULTS

Results

- **Table 2**
  - **Dependent variable: Loan_accept**
  - **Columns (main indep. variable)**
    - (1): Asset_damage = Land_value_loss
    - (2): Asset_damage = Nonland_value_loss
    - (3): Asset_damage = Asset_value_loss (= Land_value_loss + Nonland_value_loss)
    - (4): Asset_damage = Land_value_loss and Nonland_value_loss
  - **Coefficient: marginal effects** (prob. of obtaining loans)

	(1) Asset_damage = Land_value_loss		(2) Asset_damage = Nonland_value_loss		(3) Asset_damage = Asset_value_loss		(4) Asset_damage = Land_value_loss (1行目) + Nonland_value_loss (2行目)	
	dF/dx	p-value	dF/dx	p-value	dF/dx	p-value	dF/dx	p-value
Asset_damage †	-0.18098	0.003 ***	-0.02687	0.018 **	-0.03050	0.005 ***	-0.15888	0.010 **
							-0.02029	0.072 *
Firm_damage	0.00358	0.753	0.00399	0.725	0.00471	0.678	0.00530	0.639
Bank_damage	0.03744	0.004 ***	0.03897	0.002 ***	0.03959	0.001 ***	0.03930	0.002 ***

Results

- **Table 2**
  - Asset_damage has negative effect on Prob(Loan_accept)
  - Negative effect (|Coefficient|) greater for Land_value_loss than for Nonland_value_loss
    - cf.) std. dev. of Nonland_value_loss greater by five times than that of Land_value_loss
  - Significance level greater for Land_value_loss
    - But economic significance not small for Nonland_value_loss
      - Increase in Nonland_value_loss by 1 sigma decreases Prob(Loan_accept) by 0.892% point

	(1) Asset_damage = Land_value_loss		(2) Asset_damage = Nonland_value_loss		(3) Asset_damage = Asset_value_loss		(4) Asset_damage = Land_value_loss (1行目) + Nonland_value_loss (2行目)	
	dF/dx	p-value	dF/dx	p-value	dF/dx	p-value	dF/dx	p-value
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--- consistent with the collateral channel

Results

- **Table 2**
  - Other findings
    - Damage in top lenders (Bank_damage) → larger Prob(Loan_accept)
      - More lending capacity due to capital injection(?) (Uchida et al. 2014)
    - Debt reduction from non-top lenders (Debt_reduction_nonmain) → smaller Prob(Loan_accept)
      - (→ additional analysis to identify the causality)
    - Damage to suppliers (Supplier_damage) → smaller Prob(Loan_accept)
    - More compensation for nuclear damages → smaller Prob(Loan_accept)
      - huge loss from nuclear damages(?)

Results

- **Table 2**
  - Other findings
    - Better pre-earthquake performance (smaller Business_condition) → larger Prob(Loan_accept)
    - Larger firms (ln(Capitalization)) → larger Prob(Loan_accept)
    - Low-leverage firms (D_high_leverage) → larger Prob(Loan_accept)

Additional analysis (1)

- **Tables 3 and 4** (sample split)
  - T3: Borrowing from the top lender
    - Exclude "Loan_accept = 1" firms that did not borrow from the top lender (N=906)
  - T4: Borrowing from the non-top lender
    - Exclude "Loan_accept = 1" firms that did borrow from the top lender (N=588)
- **Findings**
  - Similar effects of Asset_damage (Land_value_loss, Nonland_value_loss, Asset_value_loss)
  - But Nonland_value_loss less significant than in Table 2
  - |coefficients| larger in Table 4
    - Collateral channel more significant for non-top lenders (w/o close lending relationships)

Additional analysis (1)

- **Tables 3 and 4** (sample split)
  - Borrowing from the top lender
    - Exclude firms with Loan_accept that did not borrow from the top lender (N=906)
  - Borrowing from the non-top lender
    - Exclude firms with Loan_accept that did borrow from the top lender (N=588)
- **Findings**
  - Debt reduction by non-top lenders (Debt_reduction_nonmain) reduces Prob(Loan_accept) by top lenders (Table 3)
  - Debt reduction by top lenders (Debt_reduction_main) reduces Prob(Loan_accept) by non-top lenders (Table 4)
  - → Debt reduction emits a negative signal to other lenders

Additional analysis (2)

- **Tables 5 and 6** (sample split)
  - Firms with high (T5) / low (T6) pre-quake leverage
    - Leverage > 25% or < 75%
      - Not compared with median: to retain sufficient number of observations
- **Findings**
  - Similar effects of Asset_damage (Land_value_loss, Nonland_value_loss, Asset_value_loss)
  - But their |Coefficients| larger for high-leverage firms
  - → Severer financial constraint due to the loss in the collateral value for high-leverage firms
    - Who are likely to have a smaller debt capacity for additional funds
    - --- consistent with the collateral channel

CONCLUSION

Conclusion

- **What we did**
  - **examined whether the collateral channel exists**
    - "larger loss in firms' real estate → smaller probability of borrowing"?
  - **using information from a unique corporate survey**
- **What we found**
  - **Evidence consistent with the collateral channel**
    - Especially
      - in terms of the loss in the value of land
      - for highly leveraged firms

END OF PRESENTATION

THANK YOU FOR YOUR ATTENTION