

# Banking on Carbon: Corporate Lending and Cap-and-Trade Policy

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# 1. Introduction

## Motivation

- Risks related to climate change
  - ① Physical risks
  - ② Transition risks
- Transition risks are defined to be the financial risks which could result from the process of **adjustment** towards a **lower-carbon economy**.
  - ▶ Adverse impact of climate change **regulations** on greenhouse-gas (GHG) emitting firms and their creditors
- The implications of transition risks are still unknown because most jurisdictions have not implemented climate change on a large scale.

# 1. Introduction

## Motivation

- This paper exploits quasi-exogenous variation in regulatory requirements for climate change policies to identify their effect on corporate lending.
  - ▶ Specifically, periods when major climate change policies in the U.S. move through  $\Rightarrow$  Uncertainty
  - ▶ How the financial institutions deal with the **increasing** credit risk of **polluting borrowers** due to the passage of cap-and-trade legislation
- Regulations
  - 1 California cap-and-trade bills
  - 2 Waxman-Markey cap-and-trade bills

# 1. Introduction

## Background: Cap-and-trade Programs

- The goal is to reduce total GHG emissions.
  - ▶ By capping total GHG emissions at a threshold that decreases over time
- Firms must hold or purchase allowances (permits) for each unit of GHG they emit over the threshold.
  - ▶ If a company cuts its emissions, it can sell any excess permits in the trade portion of the system.
- Programs
  - 1 California bill: state-level
  - 2 Waxman-Markey bill: federal-level

# 1. Introduction

## Background: California cap-and-trade bill

- The only mandatory cap-and-trade program introduced in any state that covers the majority of firms with high GHG emissions across industries
- Requires all facilities with emissions of **more than** 25,000 CO<sub>2</sub>e per year to obtain allowances for their emissions
  - ▶ Some free allowances, but the **remaining** should be earned from auctions or markets
- Approved by the Office of Administrative Law on **December 22, 2011**
- The first phase of the program was implemented on **January 1, 2013**.
  - ▶ Gap between the dates of approval and implementation

# 1. Introduction

## Background: Waxman-Markey cap-and-trade bill

- Waxman-Markey bill was the GHG cap-and-trade program that **came closest** to passage.
  - ▶ No such program has yet been implemented at the U.S. federal level.
- The bill passed the U.S. House of Representatives on **June 26, 2009**, but failed to pass in the Senate on July 22, 2010.
- The total amount of GHG emissions in a given year would be capped relative to GHG emissions in 2005.
  - ▶ 3%, 17%, 42%, and 83% below the 2005 emissions level by 2012, 2020, 2030, and 2050, respectively

# 1. Introduction

## Waxman-Markey cap-and-trade bill: Unique Feature

- Unique  $\Rightarrow$  The program grants approximately 15% of total permits **for free** to the manufacturing industries that had an energy intensity of **at least 5%** and trade intensity of at least 15% between 2004 and 2006.
  - ▶ Used in difference-in-differences (DiD) setting

# 1. Introduction

## Credit Risk

- After the passage of but **before** the implementation/failure of the program, GHG-emitting firms and their creditors face **increased** risks.  
⇒ Operating costs & Uncertainty ↑ due to the **unknown** impact of the programs
- At the time of regulations passage, the expected economic costs for firms were **highly uncertain**.
  - ▶ Switching to low-GHG methods of production and pace of technological progress
  - ▶ Impossible to predict the allowance price with precision
- Uncertainty → Credit risk

# 1. Introduction

## Credit Risk

- Credit risk framework from the perspective of lenders

$$\text{Expected Loss} = PD \times LGD \times EAD$$

- ▶ PD: Probability of Default
  - ▶ LGD: Loss Given Default
  - ▶ EAD: Lender's Exposure to the firm At Default
- Probability of default (Trueman and Titman, 1988; Minton and Schrand, 1999)
    - ▶ Operating costs  $\uparrow \rightarrow$  Cash flow(CF)  $\downarrow$  & Variance of CF  $\uparrow \rightarrow$  PD  $\uparrow$
  - Loss given default (Shleifer and Vishny, 1997; Benmelech and Bergman, 2011)
    - ▶ CF  $\downarrow$  & Variance of CF  $\uparrow \rightarrow$  Financial health of firms in polluting industries  $\downarrow \rightarrow$  Resale value  $\downarrow$  & Collateral value  $\downarrow \rightarrow$  LGD  $\uparrow$
  - PD  $\uparrow$  & LGD  $\uparrow \Rightarrow$  Expected Loss  $\uparrow$

# 1. Introduction

## Research Questions

- Do lenders reduce exposure to high GHG-emitting firms to limit the expected loss on loans?
- Do banks gain additional flexibility to cut credit in the future?
- Answer: Yes, by shortening loan maturity and lending via credit lines instead of term loans

## 2. Data

- Credit Data
  - ▶ Loan-level data on bank lending
    - ① Federal Reserve's Y14 Collection (Y14)
    - ② Shared National Credit (SNC) Program
- Greenhouse gas emissions

## 2. Data

### Credit Data

- Y14 and SNC cover bank borrowing of a wide range of private and public firms.
- Y14
  - ▶ Starts from 2011  $\Rightarrow$  Only for California bills
  - ▶ Covers 30 banks in the US with total assets  $>$  \$50 billion
  - ▶ Info on borrower, loan commitment amount and type, interest rate, origination date, maturity date, bank internal borrower rating
- SNC
  - ▶ Covers all syndicated commitments that exceed \$20 million and are held by three or more supervised institutions
  - ▶ Loan-specific information from 1992 through 2012
  - ▶ No data on interest rate

## 2. Data

### Greenhouse Gases Emissions

- The Environmental Protection Agency (EPA) requires each production facility emitting more than 25,000 CO<sub>2</sub>e per year to report their emissions.
- Publicly available
- In 2012, the annual report covers roughly 50% of total U.S. GHG emissions.
  - ▶ Include nearly 8,000 facilities belonging to direct GHG emitters

## 2. Data

### Greenhouse Gases Emissions

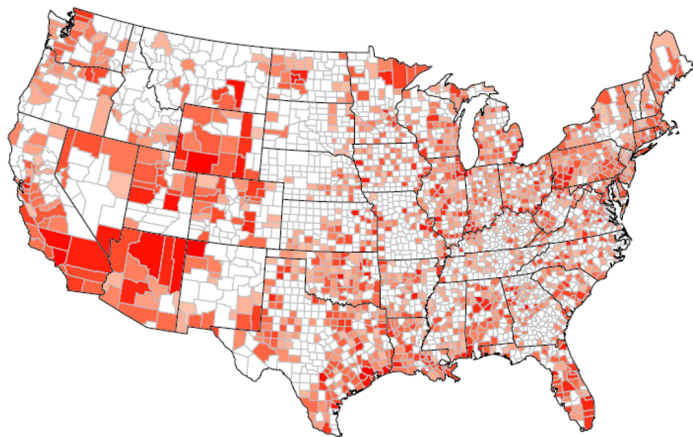


Figure 1: County-level distribution of GHG emissions as of 2012

### 3. Research Design

#### California bill

- Treated vs. Control
  - ▶ Based on the geographic location of each firm's GHG-emitting facilities
- Treatment variable (continuous)

$$CA\_Emissions\_Share_i = \frac{\sum_{k_i=1}^{K_i} FacilityEmissions_{k_i} \times I_{k_i \in CA}}{\sum_{k_i=1}^{K_i} FacilityEmissions_{k_i}}$$

- ▶  $k_i$ : a facility of firm  $i$
  - ▶  $I_{k_i \in CA}=1$  if facility  $k_i$  is located in California
- A discrete version is an indicator variable if a firm's GHG emissions in California are at least 50% of its total emissions.

### 3. Research Design

#### California bill

- DiD

$$y_{i,q} = \lambda CA\_Emissions\_Share_{i,q} \times I_{PostCAbill} + \beta_1 CA\_Emissions\_Share_{i,q} + \beta_2 Controls_{i,q} + \psi_i + \phi_{q,ind} + \epsilon_{i,q}$$

- ▶ firm  $i$  and quarter  $q$
  - ▶  $y_{i,q}$ : One of the major loan contract terms: committed credit, remaining maturity, term loans share, interest rate
  - ▶  $CA\_Emissions\_Share$  is the emission share calculated using the annual EPA data
  - ▶  $I_{PostCAbill}=1$  if the period is after the passage of the bill
- $\lambda$  captures the change in contract terms for treated firms around the bill's passage relative to those of the control firms.

### 3. Research Design

#### California bill

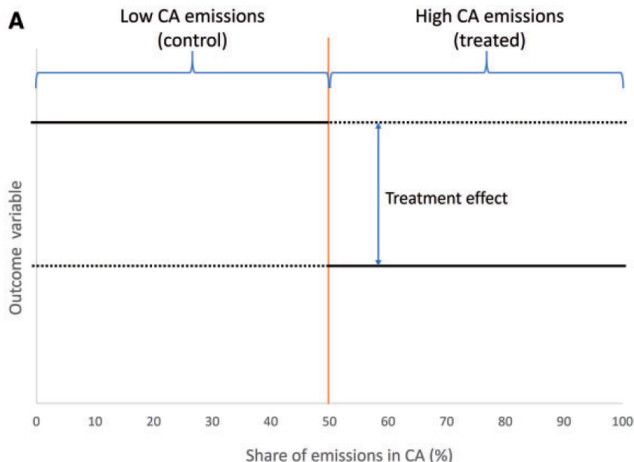


Figure 2: Identification strategy for the California bill: Cross-sectional

### 3. Research Design

#### California bill

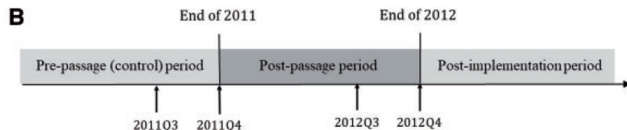


Figure 3: Identification strategy for the California bill: Time-series

- Passage of the bill: December 22, 2011
- Implementation of the bill: January 1, 2013

### 3. Research Design

#### Waxman-Markey bill

- Two time periods
  - ▶ Pre: 2008  $\Rightarrow$  Before the passage
  - ▶ Post: 2009  $\Rightarrow$  After & Under consideration by the U.S. Senate

- DiD

$$y_{i,t} = \lambda I_{i \in Treated} \times I_{t=2009} + Controls_{i,t} + \psi_i + \phi_t + \gamma_b + \epsilon_{i,t}$$

- ▶  $Treated=1$  if a firm would not receive free permits
  - ▶  $I_{t=2009}=1$  for year 2009
  - ▶ Firm, year, and lead bank fixed effects
- Baseline bandwidth includes firms in six-digit NAICS manufacturing industries that have an energy intensity between 2% and 8%.

### 3. Research Design

#### Waxman-Markey bill

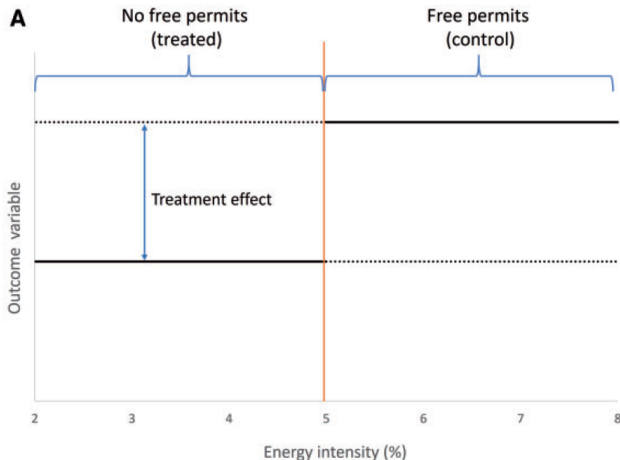


Figure 4: Identification strategy for the Waxman-Markey bill: Cross-sectional

### 3. Research Design

#### Waxman-Markey bill

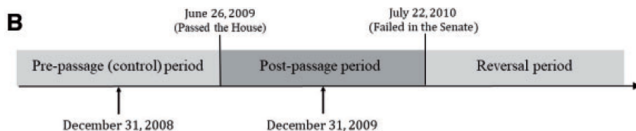


Figure 5: Identification strategy for the Waxman-Markey bill: Time-series

- Passage of the bill: June 26, 2009
- Failure to pass: July 22, 2010

### 3. Research Design

#### California bill

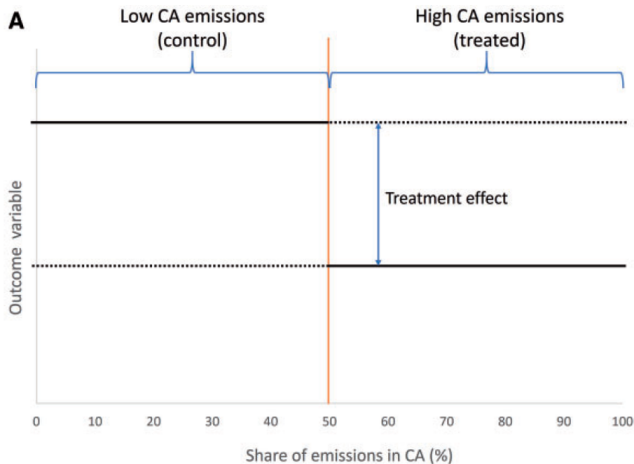


Figure 6: Identification strategy for the California bill: Cross-sectional

# 3. Research Design

## Summary Statistics: California bill

|                                           | Observations | Firms | Mean    | SD      | P10    | P50     | P90       |
|-------------------------------------------|--------------|-------|---------|---------|--------|---------|-----------|
| <i>A. Full sample</i>                     |              |       |         |         |        |         |           |
| Committed credit (in m US\$)              | 2,929        | 878   | 327.960 | 549.367 | 7.400  | 109.089 | 953.498   |
| Interest rates (in %)                     | 1,418        | 538   | 3.126   | 1.660   | 1.360  | 2.750   | 5.500     |
| Remaining maturity (in months)            | 2,929        | 878   | 34.234  | 18.389  | 7.061  | 37.553  | 56.200    |
| Share of term loans                       | 2,929        | 878   | 0.152   | 0.266   | 0.000  | 0.000   | 0.532     |
| Private                                   | 2,929        | 878   | 0.518   | 0.500   | 0.000  | 1.000   | 1.000     |
| CA emissions share                        | 2,929        | 878   | 0.067   | 0.229   | 0.000  | 0.000   | 0.102     |
| CapEx/Assets (in %)                       | 1,046        | 699   | 3.496   | 10.116  | -5.269 | 2.972   | 13.133    |
| Cash/Assets (in %)                        | 1,136        | 734   | 8.331   | 12.112  | 0.176  | 3.496   | 22.529    |
| EBITDA/Assets (in %)                      | 1,119        | 736   | 12.375  | 8.931   | 3.857  | 10.706  | 22.857    |
| <i>B. Firms with California emissions</i> |              |       |         |         |        |         |           |
| Committed credit (in m US\$)              | 410          | 127   | 624.782 | 858.426 | 10.043 | 203.557 | 1,963.848 |
| Interest rates (in %)                     | 196          | 77    | 3.103   | 1.678   | 1.391  | 2.819   | 5.257     |
| Remaining maturity (in months)            | 410          | 127   | 31.175  | 18.903  | 5.063  | 33.189  | 55.735    |
| Share of term loans                       | 410          | 127   | 0.172   | 0.292   | 0.000  | 0.026   | 0.633     |
| Private                                   | 410          | 127   | 0.385   | 0.487   | 0.000  | 0.000   | 1.000     |
| CA emissions share                        | 410          | 127   | 0.480   | 0.419   | 0.017  | 0.309   | 1.000     |
| CapEx/Assets (in %)                       | 158          | 109   | 3.344   | 8.026   | -5.116 | 3.093   | 10.046    |
| Cash/Assets (in %)                        | 166          | 112   | 11.362  | 16.792  | 0.247  | 4.329   | 29.414    |
| EBITDA/Assets (in %)                      | 165          | 112   | 11.992  | 8.253   | 3.315  | 10.802  | 21.164    |

Figure 7: Summary statistics for analyses with California bill

### 3. Research Design

#### Summary Statistics: Waxman-Markey bill

##### *A. Baseline bandwidth*

|                                | Obs. | Firms | Lead<br>banks | Mean    | SD      | P10    | P50     | P90       |
|--------------------------------|------|-------|---------------|---------|---------|--------|---------|-----------|
| Committed credit (in m US\$)   | 414  | 236   | 60            | 467.161 | 671.574 | 45.000 | 216.915 | 1,279.458 |
| Remaining maturity (in months) | 414  | 236   | 60            | 34.993  | 17.064  | 13.510 | 34.775  | 56.327    |
| Share of term loans            | 414  | 236   | 60            | 0.264   | 0.376   | 0.000  | 0.000   | 0.947     |
| Cash flow covenant             | 143  | 105   | 38            | 0.441   | 0.498   | 0.000  | 0.000   | 1.000     |
| Private                        | 414  | 236   | 60            | 0.568   | 0.496   | 0.000  | 1.000   | 1.000     |

##### *B. Wide bandwidth*

|                                | Obs. | Firms | Lead<br>banks | Mean    | SD      | P10    | P50     | P90       |
|--------------------------------|------|-------|---------------|---------|---------|--------|---------|-----------|
| Committed credit (in m US\$)   | 805  | 469   | 75            | 470.035 | 684.228 | 47.153 | 211.491 | 1,250.000 |
| Remaining maturity (in months) | 805  | 469   | 75            | 34.741  | 15.978  | 14.093 | 34.500  | 54.720    |
| Share of term loans            | 805  | 469   | 75            | 0.247   | 0.365   | 0.000  | 0.000   | 0.903     |
| Cash flow covenant             | 264  | 196   | 49            | 0.496   | 0.501   | 0.000  | 0.000   | 1.000     |
| Private                        | 805  | 469   | 75            | 0.532   | 0.499   | 0.000  | 1.000   | 1.000     |

Figure 8: Summary statistics for analyses with Waxman-Markey bill

## 4. Results

### Baseline: California bill

|                                                                  |          |          |          |          |
|------------------------------------------------------------------|----------|----------|----------|----------|
| <i>B. Remaining maturity (in months)</i>                         |          |          |          |          |
| $CA\_Emissions\_Share_i \times I_{Post\ CA\ bill}$               | -4.514*  |          | -4.723*  |          |
|                                                                  | (2.715)  |          | (2.641)  |          |
| $I_{CA\_Emissions\_Share_i \geq 50\%} \times I_{Post\ CA\ bill}$ |          | -5.001** |          | -5.137** |
|                                                                  |          | (2.506)  |          | (2.391)  |
| Observations                                                     | 2,929    | 2,929    | 2,929    | 2,929    |
| Adj $R^2$                                                        | .659     | .660     | .659     | .660     |
| <i>C. Term loans share (0 to 1)</i>                              |          |          |          |          |
| $CA\_Emissions\_Share_i \times I_{Post\ CA\ bill}$               | -0.220** |          | -0.225** |          |
|                                                                  | (0.102)  |          | (0.099)  |          |
| $I_{CA\_Emissions\_Share_i \geq 50\%} \times I_{Post\ CA\ bill}$ |          | -0.219** |          | -0.225** |
|                                                                  |          | (0.096)  |          | (0.095)  |
| Observations                                                     | 2,929    | 2,929    | 2,929    | 2,929    |
| Adj $R^2$                                                        | .554     | .558     | .555     | .559     |
| For all panels                                                   |          |          |          |          |
| Controls                                                         | No       | No       | Yes      | Yes      |
| Uninteracted variables                                           | Yes      | Yes      | Yes      | Yes      |
| Firm FE                                                          | Yes      | Yes      | Yes      | Yes      |
| Industry-quarter FE                                              | Yes      | Yes      | Yes      | Yes      |

Figure 9: Baseline result: California bill

- More decrease in remaining maturity/term loan share of affected firms after the passage of the bill relative to control firms

## 4. Results

### California bill: Private vs. Public firms

- A cap-and-trade program is likely to be **more expensive** for private firms than for public ones.
- Private firms tend to be:
  - ▶ Less emission-efficient due to their limited disclosures and regulation
  - ▶ Smaller → More affected by regulation compliance
  - ▶ More financially-constrained than public firms (Hadlock and Piercec, 2010; Saunders and Steffen, 2011; Mortal and Reisel, 2013; Erel et al., 2015; Ivanov et al., 2022)

## 4. Results

### California bill: Private vs. Public firms

|                                                                       | Private firms         |                       |                       |                       | Public firms       |                    |                    |                    |
|-----------------------------------------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|
|                                                                       | (1)                   | (2)                   | (3)                   | (4)                   | (5)                | (6)                | (7)                | (8)                |
| <i>B. Remaining maturity (in months)</i>                              |                       |                       |                       |                       |                    |                    |                    |                    |
| $CA\_Emissions\_Share_i$<br>$\times I_{Post\ CA\ bill}$               | -11.737***<br>(3.759) |                       | -11.788***<br>(3.914) |                       | 1.642<br>(2.857)   |                    | 1.984<br>(2.737)   |                    |
| $I_{CA\_Emissions\_Share_i \geq 50\%}$<br>$\times I_{Post\ CA\ bill}$ |                       | -11.556***<br>(3.640) |                       | -11.461***<br>(3.740) |                    | 0.203<br>(3.073)   |                    | 0.593<br>(2.981)   |
| Observations                                                          | 1,532                 | 1,532                 | 1,532                 | 1,532                 | 1,397              | 1,397              | 1,397              | 1,397              |
| Adj $R^2$                                                             | .724                  | .725                  | .725                  | .725                  | .567               | .567               | .569               | .569               |
| <i>C. Term loans share (0 to 1)</i>                                   |                       |                       |                       |                       |                    |                    |                    |                    |
| $CA\_Emissions\_Share_i$<br>$\times I_{Post\ CA\ bill}$               | -0.522***<br>(0.142)  |                       | -0.556***<br>(0.126)  |                       | 0.060**<br>(0.024) |                    | 0.060**<br>(0.026) |                    |
| $I_{CA\_Emissions\_Share_i \geq 50\%}$<br>$\times I_{Post\ CA\ bill}$ |                       | -0.479***<br>(0.135)  |                       | -0.510***<br>(0.122)  |                    | 0.050**<br>(0.025) |                    | 0.052**<br>(0.024) |
| Observations                                                          | 1,532                 | 1,532                 | 1,532                 | 1,532                 | 1,397              | 1,397              | 1,397              | 1,397              |
| Adj $R^2$                                                             | .582                  | .586                  | .593                  | .596                  | .549               | .549               | .547               | .547               |

Figure 10: California bill: Private vs. Public firms

## 4. Results

### California bill: Interest rate on Private vs. Public firms

|                                                                  | Full sample      |                  |                  |                  | Private firms      |                    |                    |                    | Public firms     |                  |                  |                  |
|------------------------------------------------------------------|------------------|------------------|------------------|------------------|--------------------|--------------------|--------------------|--------------------|------------------|------------------|------------------|------------------|
|                                                                  | (1)              | (2)              | (3)              | (4)              | (5)                | (6)                | (7)                | (8)                | (9)              | (10)             | (11)             | (12)             |
| $CA\_Emissions\_Share_i \times I_{Post\ CA\ bill}$               | 0.858<br>(0.542) |                  | 0.798<br>(0.531) |                  | 1.606**<br>(0.773) |                    | 1.661**<br>(0.772) |                    | 0.373<br>(0.947) |                  | 0.345<br>(0.838) |                  |
| $I_{CA\_Emissions\_Share_i \geq 50\%} \times I_{Post\ CA\ bill}$ |                  | 0.577<br>(0.426) |                  | 0.608<br>(0.420) |                    | 1.567**<br>(0.689) |                    | 1.598**<br>(0.696) |                  | 0.022<br>(0.534) |                  | 0.069<br>(0.487) |
| Observations                                                     | 1,418            | 1,418            | 1,418            | 1,418            | 688                | 688                | 688                | 688                | 730              | 730              | 730              | 730              |
| Adj $R^2$                                                        | .729             | .727             | .733             | .731             | .820               | .821               | .834               | .835               | .634             | .633             | .636             | .634             |
| Controls                                                         | No               | No               | Yes              | Yes              | No                 | No                 | Yes                | Yes                | No               | No               | Yes              | Yes              |
| Uninteracted variables                                           | Yes              | Yes              | Yes              | Yes              | Yes                | Yes                | Yes                | Yes                | Yes              | Yes              | Yes              | Yes              |
| Firm FE                                                          | Yes              | Yes              | Yes              | Yes              | Yes                | Yes                | Yes                | Yes                | Yes              | Yes              | Yes              | Yes              |
| Industry-quarter FE                                              | Yes              | Yes              | Yes              | Yes              | Yes                | Yes                | Yes                | Yes                | Yes              | Yes              | Yes              | Yes              |

Figure 11: California bill: Interest rate on Private vs. Public firms

- A bank also requires **higher** interest rates for loans to high GHG-emitting firms.
  - ▶ Only private firms

## 4. Results

### Baseline: Waxman-Markey bill

|                                           | All firms           |                    |                    |                    | Private firms        |                      |                      |                      | Public firms     |                  |                  |                  |
|-------------------------------------------|---------------------|--------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|------------------|------------------|------------------|------------------|
|                                           | (1)                 | (2)                | (3)                | (4)                | (5)                  | (6)                  | (7)                  | (8)                  | (9)              | (10)             | (11)             | (12)             |
| <i>B. Remaining maturity (in months)</i>  |                     |                    |                    |                    |                      |                      |                      |                      |                  |                  |                  |                  |
| $I_{t \in Treated} \times I_{t=2009}$     | -5.848<br>(4.001)   |                    | -6.062<br>(3.814)  |                    | -9.995<br>(5.945)    |                      | -10.478*<br>(5.230)  |                      | 0.734<br>(2.857) |                  | 0.213<br>(2.674) |                  |
| $I_{t \in TreatedWide} \times I_{t=2009}$ |                     | -4.122<br>(3.708)  |                    | -4.258<br>(3.676)  |                      | -8.115<br>(5.422)    |                      | -8.474*<br>(4.966)   |                  | 2.265<br>(2.588) |                  | 2.287<br>(2.675) |
| Observations                              | 414                 | 805                | 414                | 805                | 223                  | 393                  | 223                  | 393                  | 191              | 412              | 191              | 412              |
| Adj $R^2$                                 | .656                | .703               | .659               | .704               | .581                 | .683                 | .603                 | .691                 | .803             | .740             | .831             | .742             |
| <i>C. Term loans share (0 to 1)</i>       |                     |                    |                    |                    |                      |                      |                      |                      |                  |                  |                  |                  |
| $I_{t \in Treated} \times I_{t=2009}$     | -0.138**<br>(0.066) |                    | -0.123*<br>(0.069) |                    | -0.279***<br>(0.073) |                      | -0.247***<br>(0.068) |                      | 0.021<br>(0.092) |                  | 0.018<br>(0.097) |                  |
| $I_{t \in TreatedWide} \times I_{t=2009}$ |                     | -0.113*<br>(0.064) |                    | -0.116*<br>(0.061) |                      | -0.238***<br>(0.065) |                      | -0.230***<br>(0.060) |                  | 0.035<br>(0.080) |                  | 0.023<br>(0.081) |
| Observations                              | 414                 | 805                | 414                | 805                | 223                  | 393                  | 223                  | 393                  | 191              | 412              | 191              | 412              |
| Adj $R^2$                                 | .640                | .641               | .676               | .643               | .653                 | .662                 | .704                 | .664                 | .655             | .630             | .654             | .659             |
| For all panels:                           |                     |                    |                    |                    |                      |                      |                      |                      |                  |                  |                  |                  |
| Controls                                  | No                  | No                 | Yes                | Yes                | No                   | No                   | Yes                  | Yes                  | No               | No               | Yes              | Yes              |
| Firm FE                                   | Yes                 | Yes                | Yes                | Yes                | Yes                  | Yes                  | Yes                  | Yes                  | Yes              | Yes              | Yes              | Yes              |
| Year FE                                   | Yes                 | Yes                | Yes                | Yes                | Yes                  | Yes                  | Yes                  | Yes                  | Yes              | Yes              | Yes              | Yes              |
| Lead bank FE                              | Yes                 | Yes                | Yes                | Yes                | Yes                  | Yes                  | Yes                  | Yes                  | Yes              | Yes              | Yes              | Yes              |

Figure 12: Baseline: Waxman-Markey bill

## 4. Results

### Waxman-Markey bill: Cash flow covenants

- A cash flow covenant requires the borrowing firm to meet certain financial thresholds, and violating this covenant can trigger re-pricing or more intensive monitoring from the lender.
  - ▶ Tool for active monitoring and risk mitigation
- Dep: An indicator = 1 if the firm has a cash flow covenant
- Loans to firms with no free permit tend to be more likely to include a cash flow covenant.

|                                           | (1)                | (2)                | (3)                | (4)                | (5)                | (6)                | (7)              | (8)                |
|-------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------------|--------------------|
| $I_{i \in Treated} \times I_{t=2009}$     | 0.319**<br>(0.129) |                    | 0.320**<br>(0.136) |                    | 0.275**<br>(0.130) |                    | 0.186<br>(0.114) |                    |
| $I_{i \in TreatedWide} \times I_{t=2009}$ |                    | 0.264**<br>(0.100) |                    | 0.234**<br>(0.098) |                    | 0.289**<br>(0.116) |                  | 0.245**<br>(0.113) |
| Observations                              | 143                | 264                | 143                | 264                | 143                | 264                | 143              | 264                |
| Adj $R^2$                                 | .606               | .643               | .613               | .642               | .657               | .629               | .674             | .624               |
| Controls                                  | No                 | No                 | No                 | No                 | Yes                | Yes                | Yes              | Yes                |
| Lead bank FE                              | No                 | No                 | Yes                | Yes                | No                 | No                 | Yes              | Yes                |
| Firm FE                                   | Yes                | Yes                | Yes                | Yes                | Yes                | Yes                | Yes              | Yes                |
| Year FE                                   | Yes                | Yes                | Yes                | Yes                | Yes                | Yes                | Yes              | Yes                |

Figure 13: Waxman-Markey bill and Cash flow covenants

## 5. Conclusion

- This paper investigates how lenders manage climate policy risk and the associated impact on emitting firms.
- Two empirical settings
  - ① California cap-and-trade bill
  - ② Waxman-Markey cap-and-trade bill
- Cap-and-trade programs lead to significant changes in corporate lending to affected firms.
  - ▶ Mainly concentrated among private firms