# Crowding Out Effects in Local Corporate Sustainability Progress: Estimates from Wildfires

Ioannis Branikas*, Gabriel Buchbinder*,
Yugang Ding† and Nan Li‡

*University of Oregon
†Guangdong University of Foreign Studies
‡University of Toronto

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# Context: The role local governments' in implementing and advancing environmnetal sustainability

- Operating within subnational frameworks, local governments:
  1. control land use through planning and zoning
  2. administer building and resilience codes
  3. set and monitor clean-energy standards
  4. coordinate disaster preparedness and response

- Therefore, through:
  1. permitting
  2. enforcement
  3. procurement
  4. incentive mechanisms

  local governments' programs and commitments materially shape firms' investments in environmental sustainability

# Motivation: The Interplay Between Local Governments and Local Firms in Enhancing Corporate Sustainability

- Recent studies in finance, accounting, and management have emphasized the role of local governments in **regulating, supervising, and pressuring local firms** to promote sustainability
- Some studies have also reported a **complementarity** effect in the sustainability policies of local governments and firms [e.g., Chen, Zhang, and Zeng (2020), Baiardi and Soana (2023)]
- However, an important but underemphasized result of **classic public-goods theory**: *When governments provide – or pledge to provide – public goods such as disaster relief, risk mitigation, and notably sustainability initiatives, private contributions can be **crowded out*** [e.g., Warr (1982), Roberts (1984)]
- Estimating crowding-out effects is essential for predicting the overall trajectory of environmental sustainability in an area and policymaking

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# Idea: Estimate crowding-out effects using salience shocks generated by wildfires

- Estimating crowding-out effects poses familiar identification challenges, since public and private contributions to sustainability may be jointly determined by unobserved factors (literature on government versus individual donations)
- A growing corporate finance literature uses disasters as exogenous shocks to stakeholder salience, examining how firms adjust their environmental and social behavior in response
  - Such events are plausibly exogenous to firms
  - This literature has not explored whether public intervention can crowd out corporate sustainability efforts
- Conditional on local governments' participation in voluntary environmental programs, we test whether variation in the intensity of their engagement generates a layer of heterogeneity in firms' sustainability responses

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# Our Paper: The effect of wildfires on local corporate sustainability growth **conditional on local governments' participation** & **commitment** in environmental programs

- The type of environmental disasters that we study is wildfires
  1. frequent in the U.S. (about 1,000 large fires every year burning a total area of the size of Vermont or New Hampshire)
  2. Widely studied by environmental scientists due to their association with global warming [e.g., Abatzoglou and Williams (2016)]
  3. Ignite in forested or wildland areas rather than at corporate facilities, so direct operational exposure at plants or divisions is limited

- Extract data from ICLEI - Local Governments for Sustainability (International Council for Local Environmental Initiatives)
  - A global NGO that provides to local authorities consulting, technical guidance, and monitoring services on voluntary environmental programs
  - Services subject to the payment of fees that depend on the income and population of the given area

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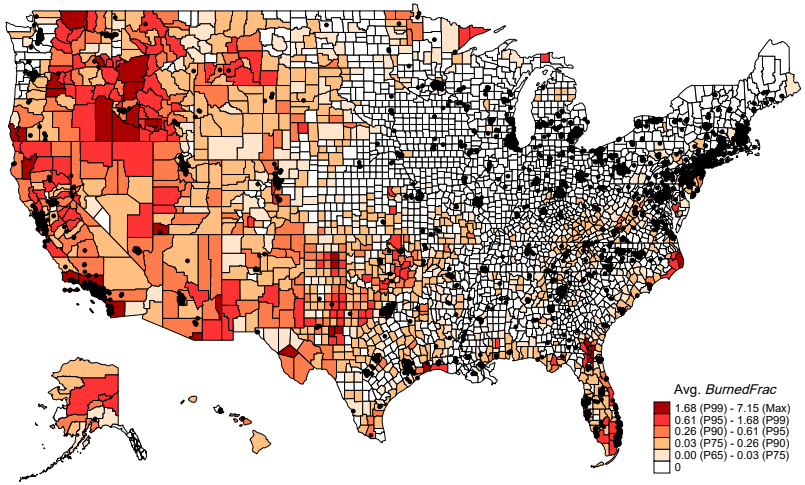
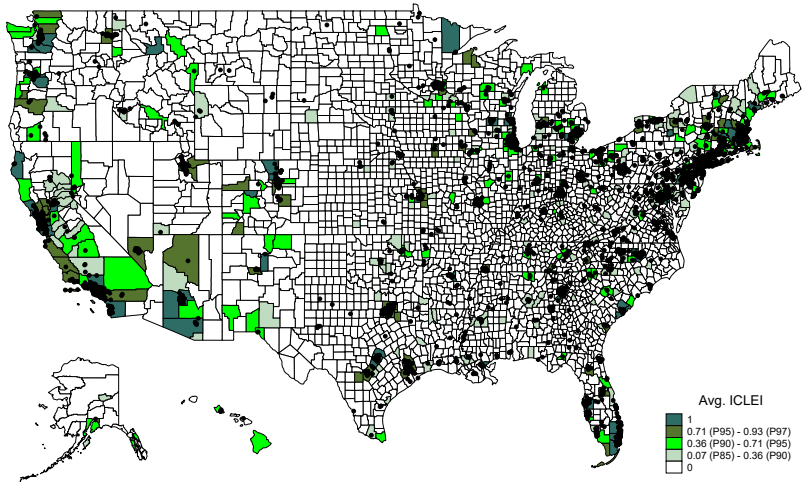
# Visualization of data on counties' wildfire severity and their local governments' participation and commitments in ICLEI

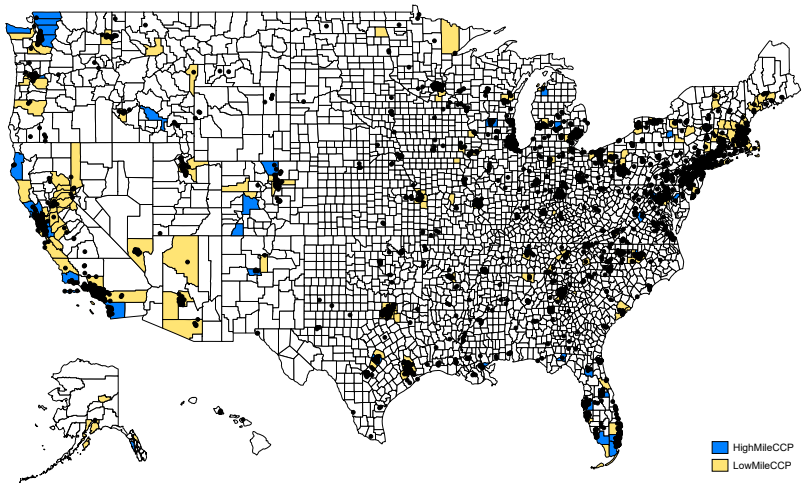
(a) Counties' average fraction of wildfire burned area from 2003 to 2016



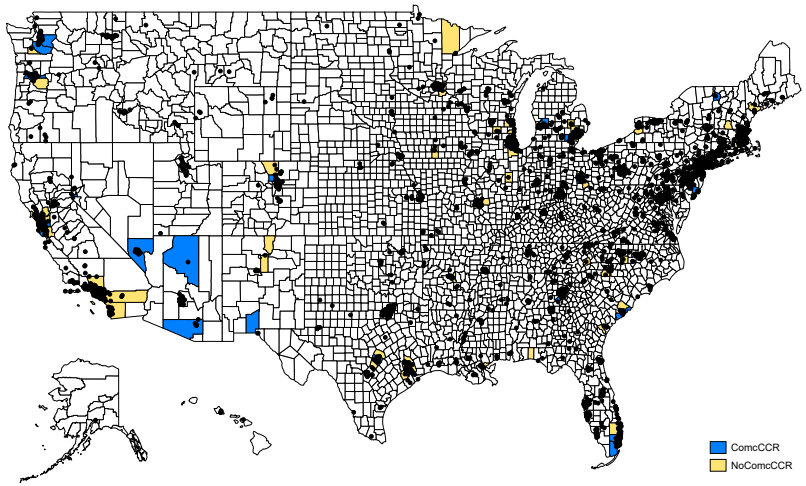

(b) Counties' local governments' average participation in an ICLEI program from 2003 to 2016




(c) *LowMileCCP* and *HighMileCCP* counties during the subperiod 2003-2010

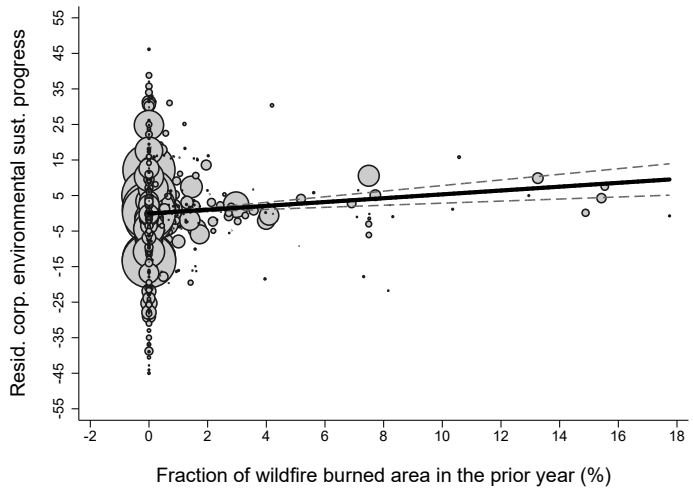



(d) *NoCommitCCR* and *CommitCCR* counties during the subperiod 2011-2016

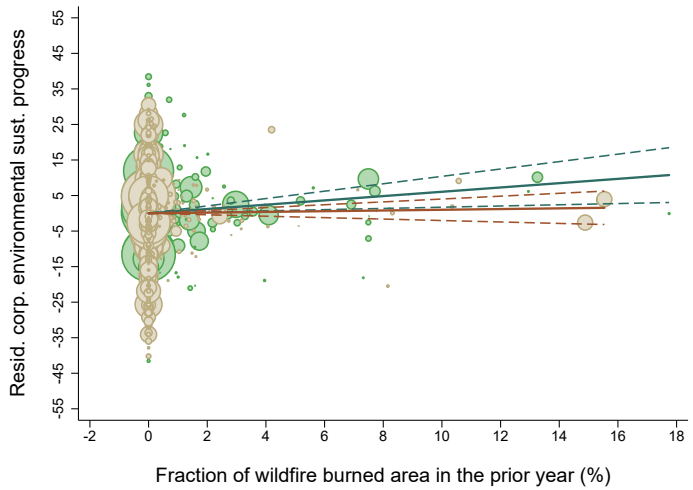


# Outline of Results

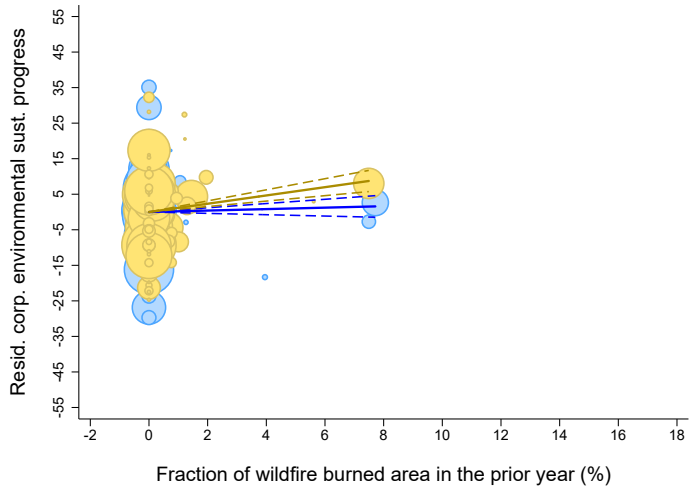
(a) All counties



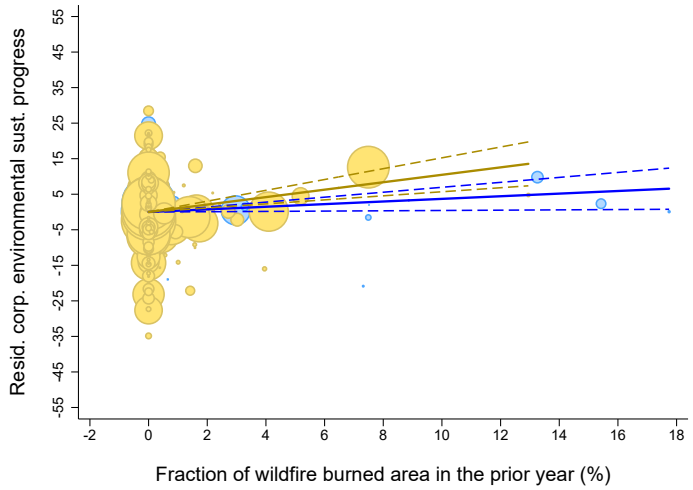

(b) *ICLEI* (green) vs. *NonICLEI* (brown)




(c) *NoCommitCCR* (yellow) vs. *CommitCCR* (blue) during 2011-2016




(d) *LowMileCCP* (yellow) vs. *HighMileCCP* (blue) during 2003-2010



# An Illustrative Theoretical Framework: Firm Stakeholders

- A locality has $N$ firms, each of which is indexed by $j$
- After an environmental disaster with severity $D > 0$, firm $j$'s stakeholders have a quasi-linear utility, with $a, b \geq 0$

$$U(c_j, g_j, G; D, \tilde{e}) = c_j + D\,\tilde{e}\,[s_j\, a \ln(g_j) + b \ln(G)]$$

  - $c_j$: consumption
  - $g_j$: firm's investment in environmental sustainability
  - $G$: env. sust. investment by local firms + the local government
  - $s_j$: size of firm $j$ (scales the warm-glow benefit upward)
  - $\tilde{e} \in \mathcal{E} \subseteq \mathbb{R}_+$: aggregate preferences for env. sustainability among the area's residents, employees, consumers, investors, civic organizations, and other local constituencies
    - Because firm $j$ operates within this locality, its stakeholders are exposed to this common environmental demand
    - Firms do *not* directly observe $\tilde{e}$ (e.g., they typically observe only their own stakeholders)

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# An Illustrative Theoretical Framework: Local Governments

- The local government collects information about $\tilde{e}$ from a broad range of local constituencies through elections, public meetings, and interactions with residents, businesses & civic organizations
- $p \in \{0,1\}$: the local government's decision to participate or not in environmental programs
  - Participation entails both direct and indirect costs, e.g., membership dues and the hiring of scientific experts or consultants
  - It is worthwhile only if local environmental demand exceeds a threshold $e^*$ beyond which the local government's perceived benefits of participation outweigh its costs: $p = \mathbf{1}\{e \geq e^*\}$
  - Observing $p$, firms update their beliefs about the magnitude of local environmental demand $\tilde{e}$, forming a posterior expectation $\hat{e}(p) \equiv \mathbb{E}[\tilde{e} \mid p] = \int_{\mathcal{E}} \tilde{e}\, d\mu(\tilde{e} \mid p)$
- When local governments participate in environmental programs, they can exhibit either a high ($m = 1$) or a low ($m = 0$) level of commitment to implementation (have many or few milestones)

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- If the income of firm $j$'s stakeholders is $y_j$, their budget is:

$$y_j = c_j + g_j + p\,\tau_j(m)$$

- These taxes, together with firms' investments in environmental sustainability, determine the total environmental sustainability investment in the area:

$$G = \sum_{j=1}^{N} [g_j + p\,\tau_j(m)] = \underbrace{g_j + \sum_{\substack{h=1 \\ h \neq j}}^{N} g_h}_{G_{\text{corp}}} + \underbrace{p \sum_{j=1}^{N} \tau_j(m)}_{T(m)}$$

  - $G_{\text{corp}}$: overall local corporate environ. sustainability investment
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# An Illustrative Theoretical Framework: Comparative Statics

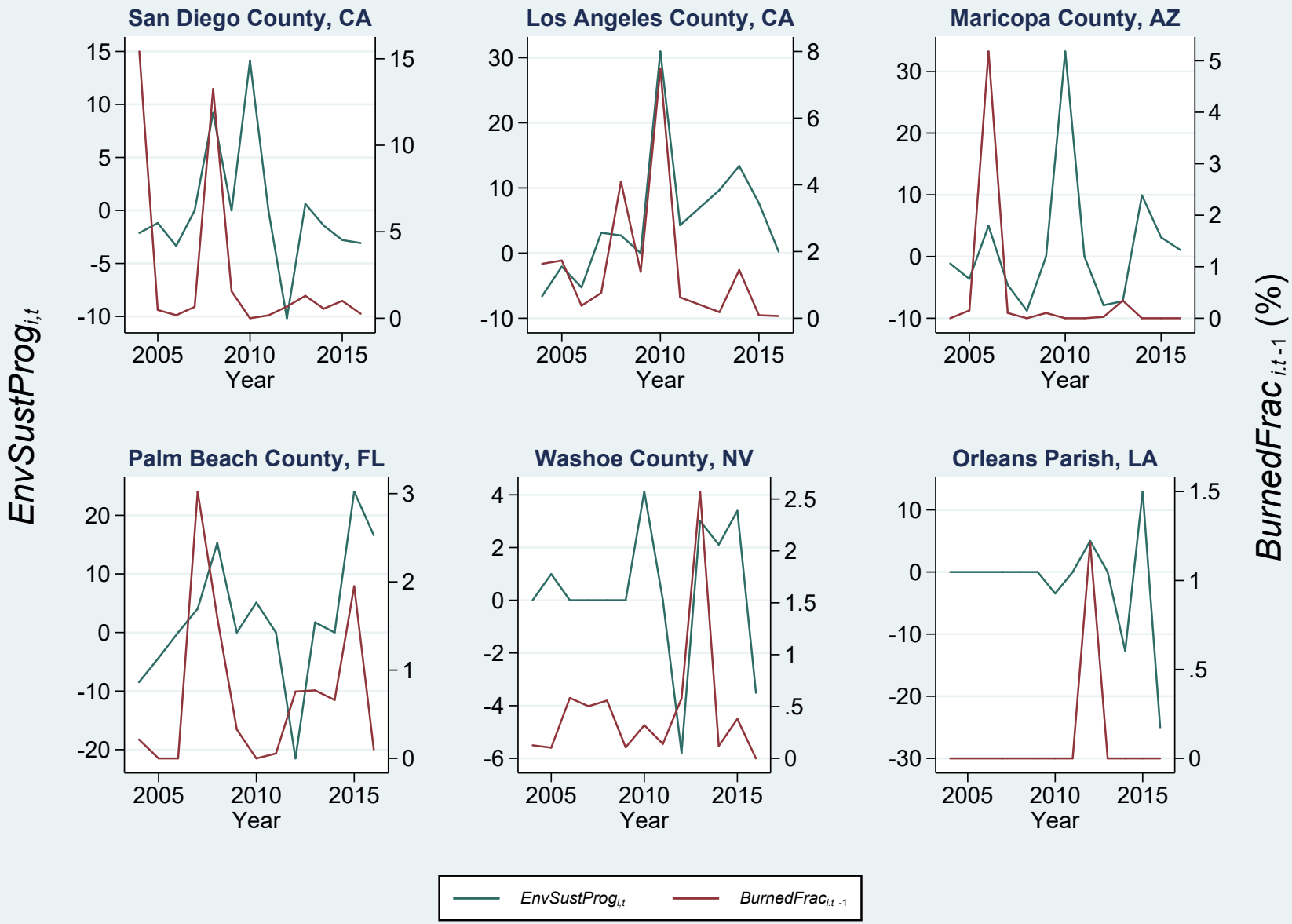
1. $\frac{\partial G_{\text{corp}}}{\partial D} > 0$: The local corporate environmental sustainability investments increase with the severity of a disaster $D$
2. $\left.\frac{\partial G_{\text{corp}}}{\partial D}\right|_{p=1} > \left.\frac{\partial G_{\text{corp}}}{\partial D}\right|_{p=0}$: The local government's participation in env. programs strengthens the disaster-induced increase in local corporate environmental sustainability investments
3. $\left.\frac{\partial\left(\frac{\partial G_{\text{corp}}}{\partial D}\right)}{\partial T(m)}\right|_{p=1} < 0$: Higher taxes weaken the disaster-induced increase in local corporate environmental sustainability investments $\Rightarrow$ when local governments commit to implementing env. programs ($m = 1$), the increase in $G_{\text{corp}}$ after disasters is **crowded out**

# Counties' corporate environmental sustainability *progress*

- Firm-year-level data from the MSCI ESG KLD STATS database
  - All the firms in the Russell 3000 universe since the year 2003 (about 98% of the U.S. stock market's market capitalization)
  - The last year in our dataset is 2016
- Assign firms to about 430 counties (14% coverage of the U.S.) using the address ZIP-Code of their headquarters from EDGAR
  - Each local firm's contribution is proportional to its size (e.g., *book value*, *market cap* or *total assets*)
  - County $i$'s 'corporate environmental sustainability progress' is defined as the size-weighted average change of its firms' scores

$$EnvSustProg_{i,t} \equiv \sum_{j \in \mathcal{N}_{i,t} \cap \mathcal{N}_{i,t-1}} \frac{Size_{j,t-1}}{TotSize_{i,t-1}} (EnvSust_{j,t} - EnvSust_{j,t-1})$$

# Six time series plots of $EnvSustProg_{i,t}$ and $BurnedFrac_{i,t-1}$ in counties exhibiting distinct positive patterns



# Econometric Model

$$EnvSustProg_{i,t} = \alpha + \beta BurnedFrac_{i,t-1} + \boldsymbol{\gamma}' \boldsymbol{X}_{i,t-1} + \delta_i + \theta_t + \epsilon_{i,t}$$

- $\boldsymbol{X}_{i,t-1}$: vector of controls (e.g., aggregate market cap, income per capita, book-to-income ratio, population, unemployment)
- $\theta_t$: year FE (e.g., the U.S. becomes more sustainable over time)
- $\delta_i$: county FE (e.g., topography and ecosystem)
- $\epsilon_{i,t}$: a random, mean independent, disturbance

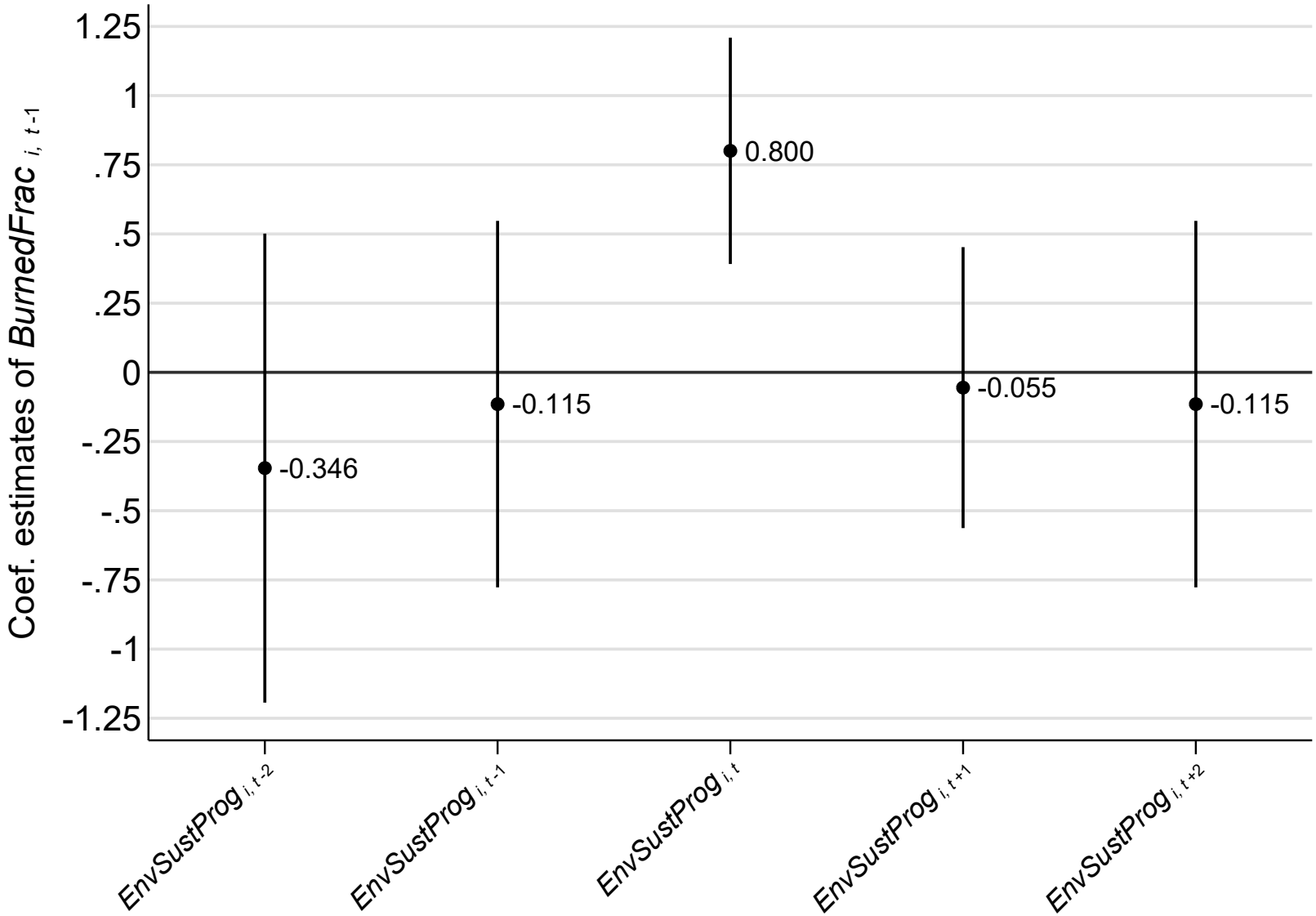
Weight the regression by the total size of county $i$'s firms

# OLS regression of $EnvSustProg_{i,t}$ on $BurnedFrac_{i,t-1}$

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| *BurnedFrac* | 0.779*** | 0.800*** | 0.630** | 0.745*** | 0.701*** |
| | (0.176) | (0.188) | (0.267) | (0.221) | (0.251) |
| log(*MarketCap*) | | -1.827 | -0.156 | -0.773 | -1.164 |
| | | (1.275) | (0.467) | (0.854) | (1.132) |
| *RATIO* | | 1.136* | 1.049** | -0.270 | 1.334* |
| | | (0.575) | (0.486) | (0.892) | (0.736) |
| log(*Pop*) | | 9.789 | 0.793 | -19.866 | 7.745 |
| | | (12.449) | (0.604) | (13.805) | (14.348) |
| log(*IncPerCap*) | | -13.657 | -3.583*** | 0.123 | -13.507 |
| | | (10.970) | (1.371) | (12.145) | (11.547) |
| *Unemp* | | -0.725 | -0.464* | 1.567* | -0.755 |
| | | (0.878) | (0.267) | (0.860) | (0.879) |
| County FE | ✓ | ✓ | | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | | ✓ |
| State-year FE | | | | ✓ | |
| Industries' yearly relative sizes | | | | | ✓ |
| Average number of counties | 430 | 430 | 430 | 430 | 430 |
| Number of years | 14 | 14 | 14 | 14 | 14 |
| $R^2$ | 0.426 | 0.435 | 0.401 | 0.702 | 0.443 |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Pre- and Post-Trends Analysis

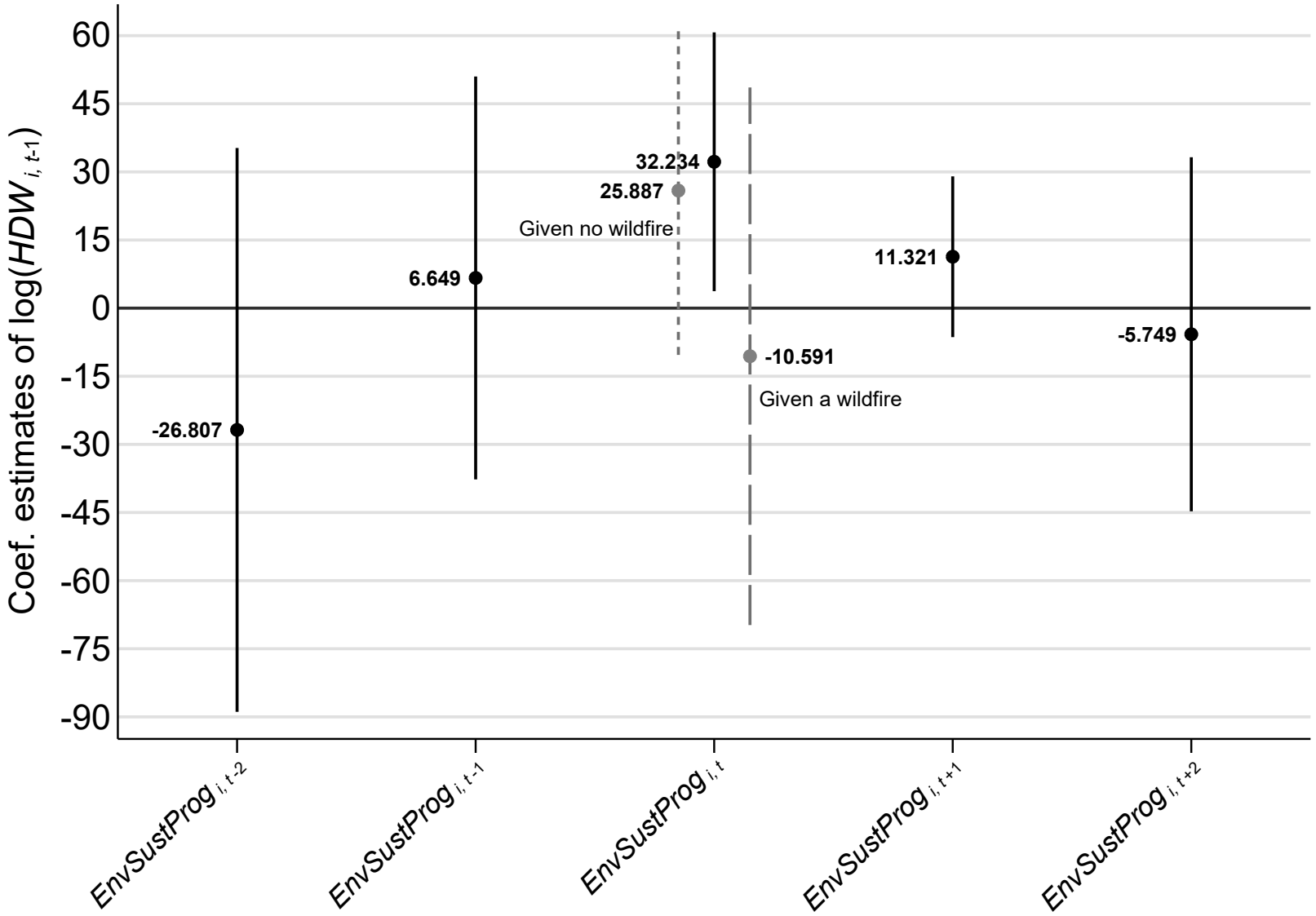


# IV reg. using the Hot-Dry-Windy Index as an instrument

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | OLS | IV regressions | | |
| | | 1st stage Tobit | 3rd stage | Reduced form |
| *BurnedFrac* | 0.815*** | | 1.347*** | |
| | (0.174) | | (0.492) | |
| $\log(\overline{HDW})$ | | 32.130*** | | 32.234** |
| | | (11.134) | | (14.537) |
| $\log(\overline{HighTMP})$ | -27.235 | 6.691 | -26.653 | -22.112 |
| | (23.579) | (17.018) | (20.779) | (20.586) |
| $\log(\overline{HighWND})$ | -13.534 | -21.209** | -13.849 | -26.596** |
| | (9.055) | (10.514) | (14.980) | (13.279) |
| $\log(\overline{HighVPD})$ | 20.384 | -30.908** | 20.079 | -17.155 |
| | (14.301) | (14.292) | (12.392) | (11.691) |
| Controls | ✓ | ✓ | ✓ | ✓ |
| County FE | ✓ | ✓ | ✓ | ✓ |
| Year FE | ✓ | ✓ | ✓ | ✓ |
| Avg. number counties | 289 | 289 | 289 | 289 |
| Number of years | 14 | 14 | 14 | 14 |
| $R^2$ | 0.448 | 0.522 (pseudo) | 0.449 | 0.452 |

regressions weighted by the total size of a county's firms
(2-way clustered se's at the county and year level in Columns 1, 2 and 4)
(Bootstrapped se's clustered by county and stratified by the number of years a county is observed in Column 3)

# IV reduced form regressions in counties with weather stations



# Regressions of $EnvSustProg_{i,t}$ on $BurnedFrac_{i,t-1}$ in subsamples based on the...

| | (1) | (2) | (3) |
|---|---|---|---|
| ***ICLEI membership or participation in an ICLEI program*** | | | |
| | *ICLEI* | *NonICLEI* | Difference |
| *BurnedFrac* | 0.835*** | 0.200 | 0.635** |
| | (0.254) | (0.193) | (0.320) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 161 | 269 | |
| Number of years | 14 | 14 | |
| $R^2$ | 0.518 | 0.327 | |
| ***Public pressure for climate protection*** | | | |
| | *PubPres* | *NoPubPres* | Difference |
| *BurnedFrac* | 0.799*** | -1.508 | 2.307* |
| | (0.200) | (1.024) | (1.214) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 130 | 41 | |
| Number of years | 14 | 14 | |
| $R^2$ | 0.421 | 0.290 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Reg. of $EnvSustProg_{i,t}$ on $BurnedFrac_{i,t-1}$ in subsamples conditional on the *ICLEI* affiliation & based on ...

| | (1) | (2) | (3) |
|---|---|---|---|
| ***Commitments in the carbonn Cities Climate Registry during the period 2011-2016*** | | | |
| | *NoCommitCCR* | *CommitCCR* | Difference |
| *BurnedFrac* | 1.880*** | 0.151 | 1.729*** |
| | (0.447) | (0.348) | (0.566) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 47 | 27 | |
| Number of years | 6 | 6 | |
| $R^2$ | 0.627 | 0.589 | |
| | *NoFileCCR* | *CommitCCR* | Difference |
| *BurnedFrac* | 2.257*** | 0.151 | 2.106** |
| | (0.820) | (0.348) | (0.992) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 90 | 27 | |
| Number of years | 6 | 6 | |
| $R^2$ | 0.486 | 0.589 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Reg. of $EnvSustProg_{i,t}$ on $BurnedFrac_{i,t-1}$ in subsamples conditional on the *ICLEI* affiliation & based on ...

| | (1) | (2) | (3) |
|---|---|---|---|
| ***Milestones in ICLEI's CCP campaign during the period 2003-2010*** | | | |
| | *LowMileCCP* | *HighMileCCP* | Difference |
| *BurnedFrac* | 1.922*** | 0.522*** | 1.400** |
| | (0.537) | (0.167) | (0.562) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 106 | 42 | |
| Number of years | 8 | 8 | |
| $R^2$ | 0.570 | 0.784 | |
| | *ICLEInonCCP* | *HighMileCCP* | Difference |
| *BurnedFrac* | 1.474** | 0.522*** | 0.952* |
| | (0.595) | (0.167) | (0.522) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 11 | 42 | |
| Number of years | 8 | 8 | |
| $R^2$ | 0.841 | 0.784 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# PSM subsample analyses by the ICLEI affiliation and commitment of counties' local governments

| | (1) | (2) | (3) |
|---|---|---|---|
| *Panel A: Logistic regressions of local governments' ICLEI affiliation and commitment on baseline controls and additional covariates used in PSM. The dependent variables are, respectively, the indicators:* | | | |
| | *ICLEI* | *CommitCCR* during 2011-2016 | *HighMileCCP* during 2003-2010 |
| *ForestFrac* | 0.002 | 0.012 | 0.001 |
| | (0.004) | (0.012) | (0.008) |
| *CollegeFrac* | 0.069*** | 0.162*** | 0.093** |
| | (0.019) | (0.057) | (0.037) |
| *GreenNGOper10K* | 1.576*** | 2.139*** | 0.414 |
| | (0.285) | (0.768) | (0.548) |
| log(*MarketCap*) | -0.033 | 0.110 | -0.022 |
| | (0.083) | (0.260) | (0.143) |
| *RATIO* | -0.217* | -0.275 | -0.047 |
| | (0.123) | (0.547) | (0.314) |
| log(*Pop*) | 1.733*** | 1.097** | 0.739** |
| | (0.147) | (0.527) | (0.347) |
| log(*IncPerCap*) | 2.107*** | -0.233 | 1.616 |
| | (0.548) | (1.182) | (1.000) |
| *Unemp* | -0.001 | 0.233 | -0.329** |
| | (0.053) | (0.155) | (0.148) |
| Year FE | YES | YES | YES |
| Average number of counties | 430 | 164 | 159 |
| Number of years | 14 | 6 | 8 |
| Pseudo $R^2$ | 0.376 | 0.218 | 0.123 |
| | (2-way clustered se's at the county and year level) | | |

# PSM subsample analyses by the ICLEI affiliation and commitment of counties' local governments - Cont'd

| | (1) | (2) | (3) |
|---|---|---|---|
| *Panel B: Regressions of EnvSustProg on BurnedFrac in propensity score-matched subsamples based on* | *ICLEI* | *NonICLEI* | Difference |
| *BurnedFrac* | 0.835*** | 0.235 | 0.600* |
| | (0.254) | (0.248) | (0.351) |
| Average number of counties | 161 | 161 | |
| Number of years | 14 | 14 | |
| $R^2$ | 0.518 | 0.329 | |
| *Panel C: Regressions of EnvSustProg on BurnedFrac in propensity score-marched subsamples based on the commitments in the carbonn Cities Climate Registry during the subperiod 2011-2016* | *NoFileCCR* or *NoCommitCCR* | *CommitCCR* | Difference |
| *BurnedFrac* | 1.086*** | 0.151 | 0.935* |
| | (0.334) | (0.348) | (0.482) |
| Average number of counties | 27 | 27 | |
| Number of years | 6 | 6 | |
| $R^2$ | 0.733 | 0.589 | |
| *Panel D: Regressions of EnvSustProg on BurnedFrac in propensity score-marched subsamples based on the milestones in ICLEI's CCP campaign during the subperiod 2003-2010* | *LowMileCCP* or *ICLEInonCCP* | *HighMileCCP* | Difference |
| *BurnedFrac* | 1.733*** | 0.522*** | 1.211*** |
| | (0.329) | (0.167) | (0.369) |
| Average number of counties | 42 | 42 | |
| Number of years | 8 | 8 | |
| $R^2$ | 0.712 | 0.784 | |
| Panels B, C, D | | | |
| Controls, county FE, year FE | Yes | Yes | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Subsample reg. of $EnvSustProg_{i,t}$ on $BurnedFrac_{i,t-1}$ in counties where *ICLEI* governments lack commitment

| | (1) | (2) | (3) |
|---|---|---|---|
| *Reg. of EnvSustProg on BurnedFrac in subsamples based on* ***firms' boards' env. exper. in:*** | | | |
| *NoCommitCCR* ***or*** *NoFileCCR* ***counties during the subperiod 2011-2016*** | | | |
| | *HighEnvExper* | *LowEnvExper* | Difference |
| *BurnedFrac* | 1.765*** | -1.477 | 3.242** |
| | (0.454) | (1.573) | (1.609) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 64 | 73 | |
| Number of years | 6 | 6 | |
| $R^2$ | 0.620 | 0.584 | |
| *LowMileCCP* ***or*** *ICLEInonCCP* ***counties during the subperiod 2003-2010*** | | | |
| | *HighEnvExper* | *LowEnvExper* | Difference |
| *BurnedFrac* | 1.846*** | -0.705 | 2.551*** |
| | (0.554) | (0.566) | (0.789) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Avg. number of counties | 57 | 60 | |
| Number of years | 8 | 8 | |
| $R^2$ | 0.618 | 0.454 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Subsample reg. of $EnvSustProg_{i,t}$ on $BurnedFrac_{i,t-1}$ in counties where *ICLEI* governments lack commitment

| | (1) | (2) | (3) |
|---|---|---|---|
| *Reg. of EnvSustProg on BurnedFrac in subsamples based on* ***firms' green inst. ownership*** *in:* | | | |
| *NoCommitCCR or NoFileCCR counties during the subperiod 2011-2016* | | | |
| | *HighGreenIO* | *LowGreenIO* | Difference |
| *BurnedFrac* | 2.070*** | -1.893 | 3.963* |
| | (0.449) | (1.858) | (2.083) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Average number of counties | 68 | 69 | |
| Number of years | 6 | 6 | |
| $R^2$ | 0.363 | 0.566 | |
| *LowMileCCP or ICLEInonCCP counties during the subperiod 2003-2010* | | | |
| | *HighGreenIO* | *LowGreenIO* | Difference |
| *BurnedFrac* | 2.454*** | -0.261 | 2.715*** |
| | (0.513) | (0.465) | (1.037) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Average number of counties | 58 | 59 | |
| Number of years | 8 | 8 | |
| $R^2$ | 0.648 | 0.646 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Subsample reg. of $EnvSustProg_{i,t}$ on $BurnedFrac_{i,t-1}$ in counties where *ICLEI* governments lack commitment

| | (1) | (2) | (3) |
|---|---|---|---|
| *Reg. of EnvSustProg on BurnedFrac in subsamples based on* ***firms' employees' and CEOs' contributions to environmentally oriented political parties*** *in:* | | | |
| *NoCommitCCR or NoFileCCR counties during the subperiod 2011-2016* | | | |
| | *HighEnvContr* | *LowEnvContr* | Difference |
| *BurnedFrac* | 1.840*** | 0.263 | 1.577* |
| | (0.449) | (0.720) | (0.831) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Average number of counties | 68 | 69 | |
| Number of years | 6 | 6 | |
| $R^2$ | 0.603 | 0.469 | |
| *LowMileCCP or ICLEInonCCP counties during the subperiod 2003-2010* | | | |
| | *HighEnvContr* | *LowEnvContr* | Difference |
| *BurnedFrac* | 2.505*** | 0.379 | 2.126** |
| | (0.480) | (0.742) | (0.868) |
| Controls, county FE, year FE | ✓ | ✓ | |
| Average number of counties | 58 | 59 | |
| Number of years | 8 | 8 | |
| $R^2$ | 0.669 | 0.633 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# External validity for the period 2007-2023: Evidence from Australian local government areas

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| *BurnedFrac* | 0.047*** | 0.041*** | 0.039** | 0.173** | 0.046** |
| | (0.013) | (0.015) | (0.017) | (0.077) | (0.022) |
| log(*Assets*) | | -0.019 | -0.009 | -0.079 | -0.043 |
| | | (0.057) | (0.017) | (0.056) | (0.068) |
| *RATIO* | | 0.002 | 0.001 | -0.009 | 0.005 |
| | | (0.007) | (0.002) | (0.007) | (0.007) |
| log(*Pop*) | | -0.282* | 0.010 | -0.461*** | -0.373** |
| | | (0.171) | (0.040) | (0.127) | (0.183) |
| log(*IncPerCap*) | | -0.532*** | 0.021 | -1.292*** | -0.353* |
| | | (0.174) | (0.075) | (0.493) | (0.210) |
| *Unemp* | | 0.027* | 0.008 | 0.001 | 0.022 |
| | | (0.016) | (0.013) | (0.022) | (0.024) |
| LGA FE | Yes | Yes | No | Yes | Yes |
| Year FE | Yes | Yes | Yes | No | Yes |
| Region-year FE | No | No | No | Yes | No |
| Industries' yearly relative sizes | No | No | No | No | Yes |
| Average number of LGAs | 40 | 40 | 40 | 40 | 40 |
| Number of years | 17 | 17 | 17 | 17 | 17 |
| $R^2$ | 0.400 | 0.415 | 0.381 | 0.667 | 0.478 |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# External validity for the period 2007-2023: Evidence from Australian local government areas - Cont'd

| | (1) | (2) | (3) |
|---|---|---|---|
| *Panel B: Regressions of EnvSustProg on BurnedFrac in subsamples based on local governments' ICLEI affiliation* | | | |
| | *ICLEI* | *NonICLEI* | Difference |
| *BurnedFrac* | 0.041*** | -0.049 | 0.090*** |
| | (0.013) | (0.048) | (0.024) |
| Average number of LGAs | 28 | 12 | |
| $R^2$ | 0.415 | 0.619 | |
| *Panel C: Regressions of EnvSustProg on BurnedFrac in subsamples based on local governments' environmental commitment (given ICLEI = 1)* | | | |
| | *LowCommit* | *HighCommit* | Difference |
| *BurnedFrac* | 0.116*** | -0.323 | 0.439** |
| | (0.025) | (0.205) | (0.207) |
| Average number of LGAs | 15 | 13 | |
| $R^2$ | 0.300 | 0.653 | |
| Panels C and D | | | |
| Controls, LGA FE, year FE | Yes | Yes | |
| Number of years | 17 | 17 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Modelling local government's objectives

- Following Heutel (2014), assume that the local government:
  - acts as the leader in a Stackelberg game with the local firms
  - benevolently maximizes the social welfare in its area, anticipating how firms' stakeholders will respond to its taxation policy
- $\Lambda_j \in (0,1)$: the social weight assigned to firm $j$'s stakeholders
- The welfare function is defined as:

$$W\left(\{\tau_j(m)\}_{j=1}^N, \{c_j\}_{j=1}^N, \{g_j\}_{j=1}^N, G; D, p\right) = \sum_{j=1}^N \Lambda_j \{c_j + D\,\hat{e}(p)\,[s_j\, a \ln(g_j) + b \ln(G)]\}$$

# Modelling local government's objectives - Cont'd

- The previous comparative statics imply a new comparative static:

$$\frac{\partial T^*(m)}{\partial D} = \frac{\hat{e}(p)\, H^* [b(H^* - 1) - A]}{H^* - 1} > 0$$

where $H^*$ is the overall investment in environmental sustainability relative to the marginal utility of its percentage increase

- **Hypothesis 4 (H4):** Severe wildfires increase the commitment of local governments participating in environmental programs in the areas where they take place

# Regressions of changes in counties' local governments' affiliation with ICLEI and their commitment within ICLEI on the fraction of their wildfire burned area

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| ***Regressions of changes in the ICLEI affiliation and political partisanship indicators*** | | | | |
| | $\Delta ICLEI$ | $\Delta Member$ | $\Delta CCP$ | $\Delta Democratic$ |
| *BurnedFrac* | -0.001 | -0.004 | 0.001 | -0.015 |
| | (0.001) | (0.007) | (0.004) | (0.023) |
| Controls, county FE, year FE | ✓ | ✓ | ✓ | ✓ |
| Avg. number of counties | 430 | 444 | 455 | 430 |
| Number of years | 14 | 11 | 8 | 4 |
| $R^2$ | 0.095 | 0.228 | 0.162 | 0.461 |
| ***Regressions of changes in the commitment indicators of local governments in ICLEI*** | | | | |
| | $\Delta FileCCR$ | $\Delta CommitCCR$ | $\Delta PerformCCR$ | |
| *BurnedFrac* | 0.001 | -0.059 | -0.052 | |
| | (0.009) | (0.171) | (0.065) | |
| Controls, county FE, year FE | ✓ | ✓ | ✓ | |
| Avg. number of counties | 164 | 74 | 74 | |
| Number of years | 6 | 6 | 6 | |
| $R^2$ | 0.756 | 0.233 | 0.286 | |

regressions weighted by the total size of a county's firms (2-way clustered se's at the county and year level)

# Practical policy recommendations

- We estimate that:
  1. $\frac{\partial G_{\text{corp}}}{\partial D} = 0.835$, based on the coefficient of *BurnedFrac* in the *ICLEI* counties (where $p = 1$)
  2. $\frac{\Delta}{\Delta m}\left(\frac{\partial G_{\text{corp}}}{\partial D}\right) \approx -1.547$, where $\Delta m$ represents a change from $m = 0$ (low commitment) to $m = 1$ (high commitment)
- Policy recommendations:
  1. Set $m = 0$ after severe disasters to avoid the $-1.547$ crowding-out effect on local corporate environmental sustainability progress
  2. If $m \in (0,1)$, then whenever the local government aims to achieve a target level $\left(\frac{\partial G_{\text{corp}}}{\partial D}\right)^*$, its commitment to env. programs should adjust by $\Delta m \approx \left[0.835 - \left(\frac{\partial G_{\text{corp}}}{\partial D}\right)^*\right]/1.547$
  3. If the revenues a local government extracts from firms in its area depend linearly on its commitment level, $T(m) = \chi + \psi \cdot m$, then they should be adjusted by $\Delta T \approx \psi\left[0.835 - \left(\frac{\partial G_{\text{corp}}}{\partial D}\right)^*\right]/1.547$
     - E.g., if $\psi = 1$ and $\left(\frac{\partial G_{\text{corp}}}{\partial D}\right)^* = 1$, then $\Delta m = \Delta T \approx -0.107$

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     - E.g., if $\psi = 1$ and $\left(\frac{\partial G_{\text{corp}}}{\partial D}\right)^* = 1$, then $\Delta m = \Delta T \approx -0.107$

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  3. If the revenues a local government extracts from firms in its area depend linearly on its commitment level, $T(m) = \chi + \psi \cdot m$, then they should be adjusted by $\Delta T \approx \psi \left[0.835 - \left(\frac{\partial G_{\text{corp}}}{\partial D}\right)^*\right] / 1.547$
     - E.g., if $\psi = 1$ and $\left(\frac{\partial G_{\text{corp}}}{\partial D}\right)^* = 1$, then $\Delta m = \Delta T \approx -0.107$

# Conclusion

Our findings elucidate how wildfires enhance the local corporate environmental sustainability growth:

*Firms in the impacted areas are keen to meet the pro-green beliefs and preferences in their areas (e.g., by relying on the environmental experience of their boards), when the local governments' commitment to voluntary environmental programs are low* $\Rightarrow$ *evidence of* ***crowding out****!*