Up in Smoke: The Impact of Wildfire Pollution on Healthcare Municipal Finance

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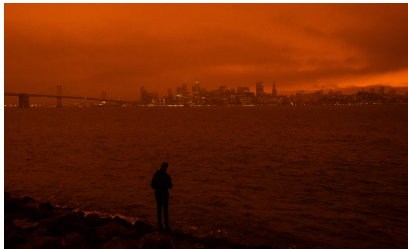
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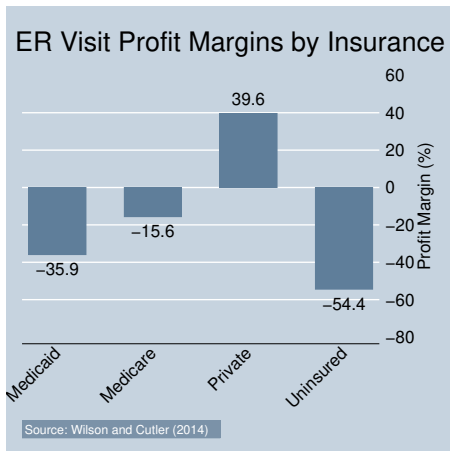# Wildfire smoke pollution triggers healthcare demand surges

Photograph: Philip Pacheco/Getty Image (McCormick, 2020)

- In California alone, over 4.3 million acres were burned by wildfires in 2020, resulting in a 15-20% surge in hospitalizations due to exposure to toxic particulate matter ($PM_{2.5}$) from smoke plumes (The Guardian, 2020).
- The 2023 Canadian wildfire smoke, which affected 122 million Americans, boosted asthma-related ER visits alone by 17% (CDC)

Municipalities outside burn regions are regularly exposed to traveling smoke plumes from distant wildfires.

Source: Daily Wildfire Smoke PM$_{2.5}$ Across US, 2020, Stanford Echo Lab.

When demand for healthcare services surges, nonprofit hospitals face considerable financial uncertainty

ER Visit Profit Margins by Insurance

Source: Wilson and Cutler (2014)

How does wildfire smoke pollution affect the credit risk of healthcare service providers?

We find that a one SD ↑ in Smoke is associated with:

1. A 7.1 bps increase in hospital borrowing costs ($175M total), and a 12.1 bps increase in nursing home borrowing costs ($95M total)

2. Decrease in hospital investment spending and average profit margin, and ↑ in uncompensated care costs (HCRIS database)

3. Out-migration primarily of residents under the age of 40 with high credit scores (FRBNY Consumer Credit Panel/Equifax database)

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Mergent Municipal Securities Data
About 80,000 municipal bond issues from 2010 to 2019

- Main dependent variable: **Offering Yield Spread**
- Difference between issue-level offering yield and coupon-equivalent risk-free rate

Variable	Hospitals	Nursing Homes	Non-Healthcare
Offering Yield Spread (bps)	97.7	167.5	31.6
Issue Size (M)	90.559	31.611	22.164
Years to Maturity	11.281	16.058	7.870
Rating Number	16.224	14.650	18.423
Unrated	0.247	0.647	0.265
General Obligation	0.176	0.068	0.673
Insured	0.042	0.014	0.145
Callable	0.892	0.969	0.714
Negotiated	0.735	0.791	0.301
N	1,060	584	76,075

Additional Bond Stats

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Wildfire Pollution Data
Stanford Echo Lab (Childs et al., 2022)

- Main independent variable: **Smoke**
- Population-weighted $PM_{2.5}$ smoke exposure across census tracts within each county-year (normalized; mean of zero, SD of 1). *Note: 1 SD is 72 $\mu g/m^3$ of $PM_{2.5}$.*
- *One large fire can drive $PM_{2.5}$ well above 180 $\mu g/m^3$ on a single day!*

Additional Smoke Stats
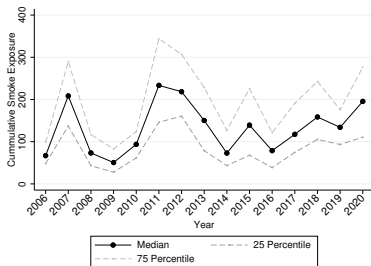
Wildfire Smoke Effect on Yield Spread

	(1) Yield Spread (%)
Smoke × Hospital	**0.071*****
	(0.021)
Smoke × Nurse	**0.121*****
	(0.040)
Smoke	0.008
	(0.006)
Controls	Yes
State-Year FE	Yes
Rating-Year FE	Yes
Insured-Year FE	Yes
Callable-Year FE	Yes
County FE	Yes
Baseline	Non-HN
Adj. R^2	0.581
N	76,863

Economic effects:

- **$175M** in interest costs for in-sample hospital issues

  (=1 SD × $24.7B × 10yrs × 7.1bps, duration approximation formula)

- **$95M** in interest costs for in-sample nursing home issues

  (=1 SD × $6B × 13yrs × 12.1bps)

- Projected interest costs of **$650M** over the following ten years

  (=0.661 SD × ($96B × 10yrs × 7.1bps + ×$19B × 13yrs × 12.1bps))

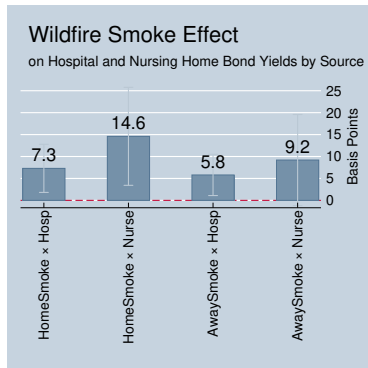Regression Model   Full Set of Results   Robustness Tests 1   Robustness Tests 2

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In-state and out-of-state wildfire smoke affects healthcare yields about equally
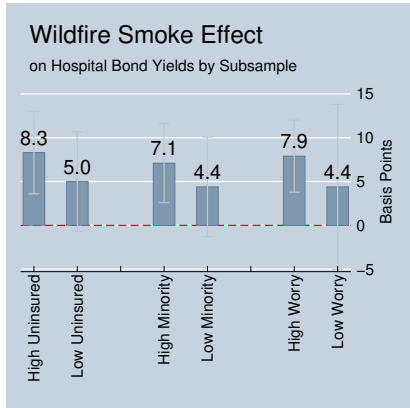
- The 2020 CA wildfires would ↑ total interest costs of an average $90M hospital issue in NV by **$1.3 million**
  (=2.5 SD × $90M × 10*years* × 5.8*bps*)

- Externality? CA spends **$334/acre** less on **Prevention** than other states, and **10x** more per burned acre in **Suppression**

  - e.g., canceled about $155 million in funds that were meant for community protection and wildland fuel reduction (LA Times, 2020).

Wildfire Smoke Effect
on Hospital and Nursing Home Bond Yields by Source

7.3	14.6	5.8	9.2

HomeSmoke × Hosp
HomeSmoke × Nurse
AwaySmoke × Hosp
AwaySmoke × Nurse

Basis Points
25
20
15
10
5
0

Model   Full Results

Wildfire Smoke Effects Across Different Counties

Wildfire Smoke Effect
on Hospital Bond Yields by Subsample

County Demographics: Smoke effects are greater in high minority or high uninsured counties. Results

Local Beliefs: Smoke effects are strongest where there is high concern for climate change. Results

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How is Non-Profit Hospital Investment Spending Affected?

	(1)
	$g(NFA)_{t+2}$
InvInc	0.619***
	(0.226)
Smoke × InvInc	0.278**
	(0.126)
Smoke	-0.023*
	(0.013)
Finance Controls	Yes
State-Year FE	Yes
Hospital FE	Yes
Adj. R^2	0.280
N	6,384

We test how Smoke affects investment spending and financial constraints using data from the CMS HCRIS database

- $g(NFA)_{h,i,t+k}$ is hospital net fixed asset growth over two years (i.e., strategic investment like preparing for more patients, replacing outdated equipment, or modernizing facilities).

- $InvInc_{h,i,t}$ is endowment fund investment income as a % of fixed assets

Findings: Smoke increases investment-CF sensitivity (financial constraint) by **45%**, and reduces investment growth by **2.3%**

Hospitals Serving Highly Uninsured Counties

Wildfire Smoke Effect
on Hospital Profit Margins and % Uncompensated Care

12.9

−53.3

Basis Points

%Uncomp   Profit Margin

Sample: hospitals in above−average uninsured counties

Full Set of Results
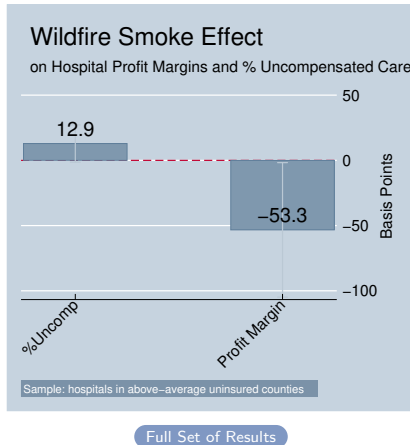
- *% Uncomp. Care* is the total uncompensated care costs as a percentage of total revenues (i.e., non-payment from uninsured patients, and lower reimbursement rates from Medicaid or Medicare insurance providers).
- *Profit Margin* is the difference between total revenues and total costs, expressed as a percentage of total revenues.

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How will the customer patient mix change over time?
Geographic Variation in Annual Cumulative Smoke Exposure
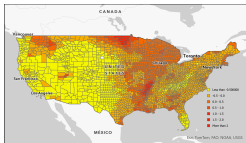
(a) 2010
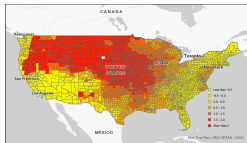
(b) 2012

(c) 2014

(d) 2016

(e) 2018

(f) 2020

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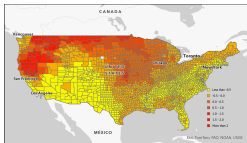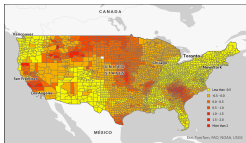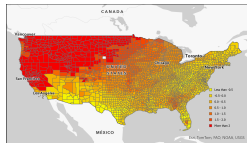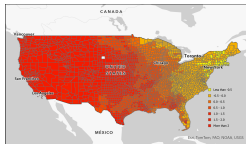
Residents aged 21 to 40 with a high credit score are most likely to leave smoke affected counties.
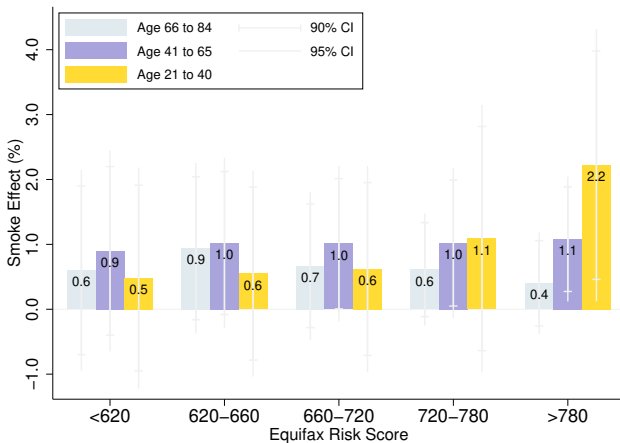
We test whether a consumer leaves because of a change in smoke exposure, over the long run (10 years) using NYFRB Equifax Consumer Credit Panel

Conclusion

1. Wildfire smoke pollution significant ↑ credit risk and ↓ investment activity and profit for healthcare service providers

   - Borrowing cost effects correspond to \$270M in realized interest costs, and another \$650M in projected interest costs
   - Smoke from out-of-state wildfires also significantly ↑ borrowing costs, suggesting that poor wildfire management imposes costly externalities on nearby states
   - If the patient mix becomes increasingly uninsured, future wildfire smoke effects on healthcare costs and profits can be expected to increase

Conclusion

1. Wildfire smoke pollution significant ↑ credit risk and ↓ investment activity and profit for healthcare service providers

   - Borrowing cost effects correspond to \$270M in realized interest costs, and another \$650M in projected interest costs
   - Smoke from out-of-state wildfires also significantly ↑ borrowing costs, suggesting that poor wildfire management imposes costly externalities on nearby states
   - If the patient mix becomes increasingly uninsured, future wildfire smoke effects on healthcare costs and profits can be expected to increase

2. Intergovernmental cooperation is crucial for addressing wildfire events and cross-state effects.

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Thank You

APPENDIX

Municipal Bond Summary Statistics by Sector (2010-2019)

Panel A: Non-Healthcare	Mean	Median	P25	P75	SD
Offering Yield Spread (%)	0.316	0.229	-0.021	0.557	0.578
Issue Size (M)	22.164	7.000	3.000	16.500	66.054
Years to Maturity	7.870	7.848	4.786	10.497	4.808
Rating Number	18.423	19.000	17.000	20.000	1.859
Unrated	0.265	0.000	0.000	1.000	0.441
General Obligation	0.673	1.000	0.000	1.000	0.469
Insured	0.145	0.000	0.000	0.000	0.352
Callable	0.714	1.000	0.000	1.000	0.452
Negotiated	0.301	0.000	0.000	1.000	0.459
Observations	76,075				

Panel B: Hospitals	Mean	Median	P25	P75	SD
Offering Yield Spread (%)	0.977	0.890	0.495	1.404	0.758
Issue Size (M)	90.559	35.148	8.777	106.520	177.646
Years to Maturity	11.281	10.323	7.698	12.916	6.564
Rating Number	16.224	16.000	15.000	18.000	2.336
Unrated	0.247	0.000	0.000	0.000	0.432
General Obligation	0.176	0.000	0.000	0.000	0.381
Insured	0.042	0.000	0.000	0.000	0.200
Callable	0.892	1.000	1.000	1.000	0.310
Negotiated	0.735	1.000	0.000	1.000	0.442
Observations	1,060				

Panel C: Nursing Homes	Mean	Median	P25	P75	SD
Offering Yield Spread (%)	1.675	1.737	0.956	2.353	0.986
Issue Size (M)	31.611	21.007	6.945	40.455	37.569
Years to Maturity	16.058	13.466	9.268	22.095	8.859
Rating Number	14.650	14.000	12.000	17.000	3.086
Unrated	0.647	1.000	0.000	1.000	0.478
General Obligation	0.068	0.000	0.000	0.000	0.253
Insured	0.014	0.000	0.000	0.000	0.116
Callable	0.969	1.000	1.000	1.000	0.173
Negotiated	0.791	1.000	1.000	1.000	0.407
Observations	584				

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Wildfire Smoke Pollution Summary Statistics

	Cumulative Smoke Exposure		Annual Smoke Days	
	(1) Mean	(2) SD	(3) Mean	(4) SD
2006	80.530	57.282	22.603	13.098
2007	223.566	138.171	38.583	15.671
2008	95.396	122.342	27.443	16.921
2009	60.500	41.738	20.725	13.695
2010	93.697	48.907	28.929	14.065
2011	251.727	140.227	54.741	25.498
2012	247.091	154.717	65.507	29.530
2013	158.325	106.096	44.989	22.520
2014	91.013	67.269	31.339	17.115
2015	173.958	158.386	38.314	23.090
2016	87.907	59.499	32.095	17.709
2017	184.599	240.326	46.064	19.485
2018	217.097	231.350	52.877	21.281
2019	140.465	64.905	48.401	15.492
2020	281.228	387.816	58.846	19.719
Decennial Change	71.522	139.437	20.000	8.236

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Hospital Financial Summary Statistics

	Mean	Median	P25	P75	SD
$g(NFA)_{t+1}$	0.034	-0.013	-0.057	0.056	0.200
$g(NFA)_{t+2}$	0.079	-0.015	-0.094	0.125	0.361
$InvInc$	0.025	0.008	0.002	0.029	0.042
$FinInv$	0.535	0.265	0.069	0.756	0.694
$g(SRev)$	0.038	0.034	-0.009	0.080	0.088
$OpInc$	0.200	0.150	-0.046	0.379	0.471
$\log(TRev)$	4.553	4.570	3.461	5.613	1.313
Observations	6,937				

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The Effect of Wildfire Smoke Pollution on Healthcare Municipal Borrowing Costs

We first test the effect of Smoke on the offering yield spreads (y_{ijt}) of hospital issues (*Hospital*) and nursing home issues (*Nurse*) relative to non-healthcare issues for issue i, county j, and year-month t

$$
\begin{aligned}
y_{ijt} &= \beta^H \cdot Smoke_{jt} \times Hospital_i + \beta^N \cdot Smoke_{jt} \times Nurse_i \quad (1) \\
&+ \beta^C \cdot Smoke_{jt} + \gamma \cdot X_{ijt} + \delta \cdot Z_{it} + \phi_{ijy} + \varepsilon_{ijt},
\end{aligned}
$$

- X_{ijt} is an issue-level vector of controls such as size, maturity, and indicators for general obligation, insured, and callability

- Z_{it} is a county-level vector of controls such as household income, gross rent, and minority population share

- ϕ_{ijy} is a vector of county, state-year, rating-year, insured-year, and callable-year fixed effects

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The Effect of Wildfire Smoke Pollution on Healthcare Municipal Borrowing Costs

	(1) Yield Spread (%)	(2) Yield Spread (%)	(3) Yield Spread (%)	(4) Yield Spread (%)
$Smoke \times Hospital$	0.071***	0.086***		
	(0.021)	(0.020)		
$Smoke \times Nurse$	0.121***	0.133***		
	(0.040)	(0.034)		
$Smoke$	0.008	0.001		
	(0.006)	(0.008)		
$SmokeDays \times Hospital$			0.061***	0.093***
			(0.021)	(0.023)
$SmokeDays \times Nurse$			0.078**	0.113***
			(0.033)	(0.034)
$SmokeDays$			0.018*	0.014
			(0.010)	(0.015)
Controls	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Rating-Year FE	Yes	Yes	Yes	Yes
Insured-Year FE	Yes	Yes	Yes	Yes
Callable-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Baseline	Non-HN	Ind. Dev.	Non-HN	Ind. Dev.
Adj. R^2	0.581	0.646	0.581	0.646
N	76,863	28,596	76,863	28,596

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Smoke Effects by County Demographics

	(1) Yield Spread (%)	(2) Yield Spread (%)	(3) Yield Spread (%)	(4) Yield Spread (%)
Smoke × Hospital	0.083***	0.050*	0.071***	0.044
	(0.024)	(0.029)	(0.023)	(0.029)
Smoke × Nurse	0.207***	0.118**	0.235***	0.108*
	(0.060)	(0.049)	(0.060)	(0.057)
Smoke	0.007	0.001	0.009	0.006
	(0.007)	(0.008)	(0.008)	(0.007)
Controls	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Rating-Year FE	Yes	Yes	Yes	Yes
Insured-Year FE	Yes	Yes	Yes	Yes
Callable-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Subsample	High Unins.	Low Unins.	High Minority	Low Minority
Adj. R^2	0.588	0.574	0.617	0.560
N	38,082	38,367	38,212	38,276

Borrowing cost effects are stronger in high uninsured and high
minority share counties Back

Smoke Effects by Bond Quality

	(1) Yield Spread (%)	(2) Yield Spread (%)	(3) Yield Spread (%)
Smoke × Hospital	-0.157*	0.080*	0.118***
	(0.085)	(0.043)	(0.024)
Smoke × Nurse	-0.096	0.000	0.225***
	(0.092)	(0.089)	(0.044)
Smoke	-0.001	0.001	0.018*
	(0.009)	(0.006)	(0.010)
Controls	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes
Rating-Year FE	Yes	Yes	Yes
Insured-Year FE	Yes	Yes	Yes
Callable-Year FE	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Rating Subsample	High	Medium	Low/Unrated
Adj. R^2	0.398	0.497	0.632
N	15,427	25,807	34,777

Borrowing cost effects are greatest for low quality bonds but lowest
for high quality bond. Back

Climate Change Beliefs

	(1) Yield Spread (%)	(2) Yield Spread (%)	(3) Yield Spread (%)	(4) Yield Spread (%)
Smoke × Hospital	0.079***	0.044	0.083***	0.036
	(0.021)	(0.048)	(0.021)	(0.050)
Smoke × Nurse	0.132***	0.016	0.123**	0.056
	(0.047)	(0.087)	(0.051)	(0.071)
Smoke	0.006	-0.004	0.006	0.013
	(0.006)	(0.010)	(0.006)	(0.012)
Controls	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Rating-Year FE	Yes	Yes	Yes	Yes
Insured-Year FE	Yes	Yes	Yes	Yes
Callable-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Subsample	High Worry	Low Worry	High Harm	Low Harm
Adj. R^2	0.602	0.513	0.604	0.513
N	61,017	15,802	59,374	17,444

Wildfire smoke is priced in the healthcare municipal bond market as long as local investors believe that wildfires will remain a permanent part of the landscape Back

Robustness Tests 1

	(1) Yield Spread (%)	(2) Yield Spread (%)	(3) Yield Spread (%)	(4) Yield Spread (%)
Smoke	0.008	0.008	0.002	0.008
	(0.005)	(0.006)	(0.006)	(0.006)
Smoke × Hospital	0.070***	0.070***	0.073***	0.080***
	(0.021)	(0.020)	(0.022)	(0.021)
Smoke × Nurse	0.094**	0.115***	0.121***	0.113***
	(0.040)	(0.037)	(0.038)	(0.038)
LagSmoke	0.006			
	(0.006)			
LagSmoke × Hospital	-0.006			
	(0.021)			
LagSmoke × Nurse	-0.011			
	(0.044)			
LeadSmoke	0.001			
	(0.004)			
LeadSmoke × Hospital	0.005			
	(0.015)			
LeadSmoke × Nurse	0.066			
	(0.041)			
Controls	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Rating-Year FE	Yes	Yes	Yes	Yes
Insured-Year FE	Yes	Yes	Yes	Yes
Callable-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Model	Lead/Lag	Fire Control	Fire Excluded	CA Excluded
Adj. R^2	0.584	0.584	0.582	0.579
N	76,522	76,522	72,899	71,499

Robustness Tests 2

	(1) y_{ijt} (Tax Adj.)	(2) y_{ijt} (Call Adj.)	(3) y_{ijt} (No Call)	(4) y_{ijt} (Raw)
Smoke	0.021^{**}	0.009	0.002	0.018^{**}
	(0.011)	(0.006)	(0.006)	(0.008)
Smoke × Hospital	0.101^{***}	0.060^{***}	0.072^{***}	0.058^{***}
	(0.034)	(0.020)	(0.024)	(0.022)
Smoke × Nurse	0.305^{***}	0.088^{**}	0.106^{*}	0.148^{***}
	(0.072)	(0.038)	(0.063)	(0.045)
Controls	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
Rating-Year FE	Yes	Yes	Yes	Yes
Insured-Year FE	Yes	Yes	Yes	Yes
Callable-Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Model	Tax Adj.	Call Adj.	No Call	Raw Yield
Adj. R^2	0.716	0.565	0.570	0.792
N	75,759	76,522	47,103	75,759

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The Effects of Smoke from Out-of-State Wildfires

Do local wildfires impose cost externalities on nearby states?

- We decompose *Smoke* into its in-state and out-of-state components using wildfire data from the Department of Homeland Security (St. Denis et al., 2023)

$$Smoke_{jsy} = \beta \cdot F_{jsy} \times \delta_s + \gamma \cdot F_{jsy} + \delta_s + \varepsilon_{jsy},$$

- $F_{j,s,y}$ is a vector of in-state wildfire variables: number of wildfires, structures damaged, number of burnt acres
- *HomeSmoke* is the (normalized) predicted component
- *AwaySmoke* is the (normalized) residual component

Out-of-State Smoke Effects

	(1) Yield Spread (%)	(2) Yield Spread (%)
HomeSmoke × Hospital	0.073**	0.095***
	(0.028)	(0.023)
HomeSmoke × Nurse	0.146**	0.150***
	(0.057)	(0.052)
AwaySmoke × Hospital	0.058**	0.059**
	(0.024)	(0.023)
AwaySmoke × Nurse	0.092*	0.097**
	(0.053)	(0.044)
AwaySmoke	0.006	-0.002
	(0.005)	(0.009)
Controls	Yes	Yes
State-Year FE	Yes	Yes
Rating-Year FE	Yes	Yes
Insured-Year FE	Yes	Yes
Callable-Year FE	Yes	Yes
County FE	Yes	Yes
Baseline	Non-HN	Ind. Dev.
Adj. R^2	0.576	0.649
N	65,343	23,046

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Prevention Underinvestment

- In California, there is a long history of under investment in prevention (Wara et al, 2020)
- CA lacks a cost-benefit framework to evaluate prevention vs suppression.
- We collect panel data from the USDA Forest Service on wildfire prevention.
- California spends \$334 less on Wildfire prevention then other states.
- Various prevention projects canceled in CA:
    - \$100M to improve infrastructure resiliency
    - \$155M for wildland fuel reduction

	(1)	Fire Prevention	(2)
		Prevention/Acre	
$\mathbf{1}_{CA}$	-333.67***		-344.23***
	(79.93)		(110.09)
N(Fires)			0.17
			(0.17)
$\mathbf{1}_{CA} \times N$(Fires)			-0.18
			(0.17)
N(Str. Damaged)			0.00
			(0.01)
$\mathbf{1}_{CA} \times N$(Str. Dmg.)			-0.00
			(0.01)
Adj. R^2	-0.001		-0.012
N	374		352

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Suppression Overinvestment

- Perhaps as a consequence of prevention underinvestment, we find evidence of suppression overinvestment in CA
- We collect panel data on wildfire suppression expenditures from ten Western US state agencies (Cook and Becker, 2017)
- CA spends over 10x per burned acre vs other Western states
- The Federal government spends almost 2x per burned acre on CA

	(1) StateExp/Acre	(2) StateExp/Acre	(3) FedExp/Acre	(4) FedExp/Acre
$\mathbf{1}_{CA}$	8555.68***	30106.22***	287.86*	1514.87***
	(2380.79)	(7428.03)	(155.31)	(376.57)
N(Fires)		-121.66***		-7.89***
		(38.09)		(2.50)
$\mathbf{1}_{CA} \times N$(Fires)		-0.61		0.82
		(2.08)		(1.75)
N(Str. Damaged)		-3.87**		0.80
		(1.65)		(0.49)
$\mathbf{1}_{CA} \times N$(Str. Dmg.)		-1.55**		-1.01**
		(0.64)		(0.48)
Adj. R^2	0.494	0.773	0.010	0.008
N	85	85	81	81

Non-Profit Hospital Outcomes

	(1) Profit Margin	(2) % Uncomp. Care	(3) Profit Margin	(4) % Uncomp. Care
Smoke	-0.533**	0.129*	-0.704	0.082
	(0.263)	(0.073)	(1.022)	(0.078)
$g(SRev)$	5.962***	-0.414	5.544	-0.157
	(1.313)	(0.447)	(5.429)	(0.378)
OpInc	0.320	0.157	4.825	-0.033
	(0.999)	(0.204)	(4.297)	(0.191)
$\log(TRev)$	-9.001***	-0.435	-39.536	1.497
	(2.741)	(0.583)	(37.961)	(1.616)
FinInv	-1.822***	-0.016	-0.944	0.137*
	(0.598)	(0.122)	(0.635)	(0.071)
Subsample	High Unins.	High Unins.	Low Unins.	Low Unins.
State-Year FE	Yes	Yes	Yes	Yes
Hospital FE	Yes	Yes	Yes	Yes
Adj. R^2	0.660	0.797	0.347	0.539
N	4,270	4,270	4,599	4,599

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Demand for Healthcare

- **ER visits are unprofitable** if the patient is Medicare-insured (-15.6% profit margin); older populations are especially vulnerable to wildfire smoke

- **ER visits are very unprofitable** if the patient is uninsured (-54.4% profit margin); uninsured patients are more likely to visit hospitals only for emergencies

- We explore the real health effects by directly examining the effect of Smoke on reported asthma cases and ER visits

  - A one SD increase in Smoke is associated with approximately 9 per 1000 ppl additional asthma cases (CDC data) Table
  - A one SD increase in Smoke is associated with approximately 2.5 per 1000 ppl additional ER visits (data obtained from the KFF and the AHA) Table

Real Health Outcomes (Asthma)

	Dep. Variable: Number of Asthma Cases (thousands)		
	(1)	(2)	(3)
Smoke	8.842***	9.693***	
	(1.055)	(1.169)	
HomeSmoke			13.995***
			(1.633)
AwaySmoke			6.387***
			(0.732)
Controls	Yes	Yes	Yes
State FE	Yes	No	Yes
County FE	No	Yes	No
Year FE	Yes	Yes	Yes
Adj. R^2	0.992	0.991	0.99
N	21,700	21,700	19,002

- Data from the CDC and the Behavioral Risk Factor Surveillance System (BRFSS) on the number of asthma cases
- A one SD increase in Smoke is associated with an additional 9 per 1000 people asthma cases
- Out-of-state smoke contributes to one-third of the Smoke effect

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Real Health Outcomes (ER)

	(1) ER Visits	(2) ER Visits	(3) Admissions	(4) Admissions
Smoke	2.448***		0.361***	
	(0.152)		(0.024)	
HomeSmoke		1.718***		0.425***
		(0.216)		(0.023)
AwaySmoke		2.200***		0.123***
		(0.134)		(0.023)
Controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.921	0.930	0.967	0.970
N	36,973	32,871	36,973	32,871

- A one SD increase in Smoke is associated with an additional 2.5 per 1000 people ER visits

- Out-of-state smoke also an important contributor to the Smoke effect

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References I

Boxall, Bettina, "Billions of Dollars Spent on Fighting California Wildfires, but Little on Prevention," 2020. Los Angeles Times. Retrieved at: `https://www.latimes.com/environment/story/2020-12-23/billions-spent-fighting-california-wildfires-little-on-p`

Childs, Marissa L, Jessica Li, Jeffrey Wen, Sam Heft-Neal, Anne Driscoll, Sherrie Wang, Carlos F Gould, Minghao Qiu, Jennifer Burney, and Marshall Burke, "Daily local-level estimates of ambient wildfire smoke PM2. 5 for the contiguous US," *Environmental Science & Technology*, 2022, *56* (19), 13607–13621.

McCormick, Erin, "Doctors Alarmed by Surge in Hospital Visits as Toxic Smoke Engulfs West Coast," 2020. The Guardian. Retrieved at: `https://www.theguardian.com/world/2020/sep/18/wildfire-smoke-health-effects-hospitals`.