

Not Everyone Recovers from
Disaster in the Same Way: Wildfire
Risk, Insurance Premiums, and
Income-Stratified Migration in
California

Marine Kang

Background

- Natural disasters in the U.S. have increased substantially over time (Boustan et al., 2020)
- Wildfires are becoming more frequent and intense, especially in California (Keeley & Syphard, 2021; Williams et al., 2019)
- Driven by:
 - Climate change (Brown et al., 2023; Williams et al., 2019)
 - Population growth & expansion into wildfire-prone areas (Keeley & Syphard, 2021)
- Wildfires affect communities through:
 - Direct physical damage
 - Changes in local economic conditions & risk expectations (Bayham et al., 2022)

Research Question

(1) How does wildfire exposure affect migration flows?

(2) How do these patterns reflect deeper transformations in lived experience under environmental risk?

Humanities Cases

Environmental Imagination (Buell, 1995)

- Perceptions of nature are shaped by cultural narratives
- “Nature as fair” is a constructed belief

Deconstruction (Derrida)

- Concepts like fairness and nature are linguistically unstable
- Meanings are shaped through language, not fixed reality

Slow Violence (Nixon, 2011)

- Environmental harm unfolds gradually over time
- Inequality becomes visible in the aftermath, not the event

Cultural Trauma (Alexander, 2004; Smelser, 2004)

- Disasters reshape collective identity
- Same event → different experiences across groups

Environmental Justice (Banzhaf & McCormick, 2007)

- Unequal outcomes driven by institutions & policy
- Vulnerable populations bear disproportionate burdens



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stically unstable
fixed reality

time

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Parable of the Sower



OCTAVIA E.
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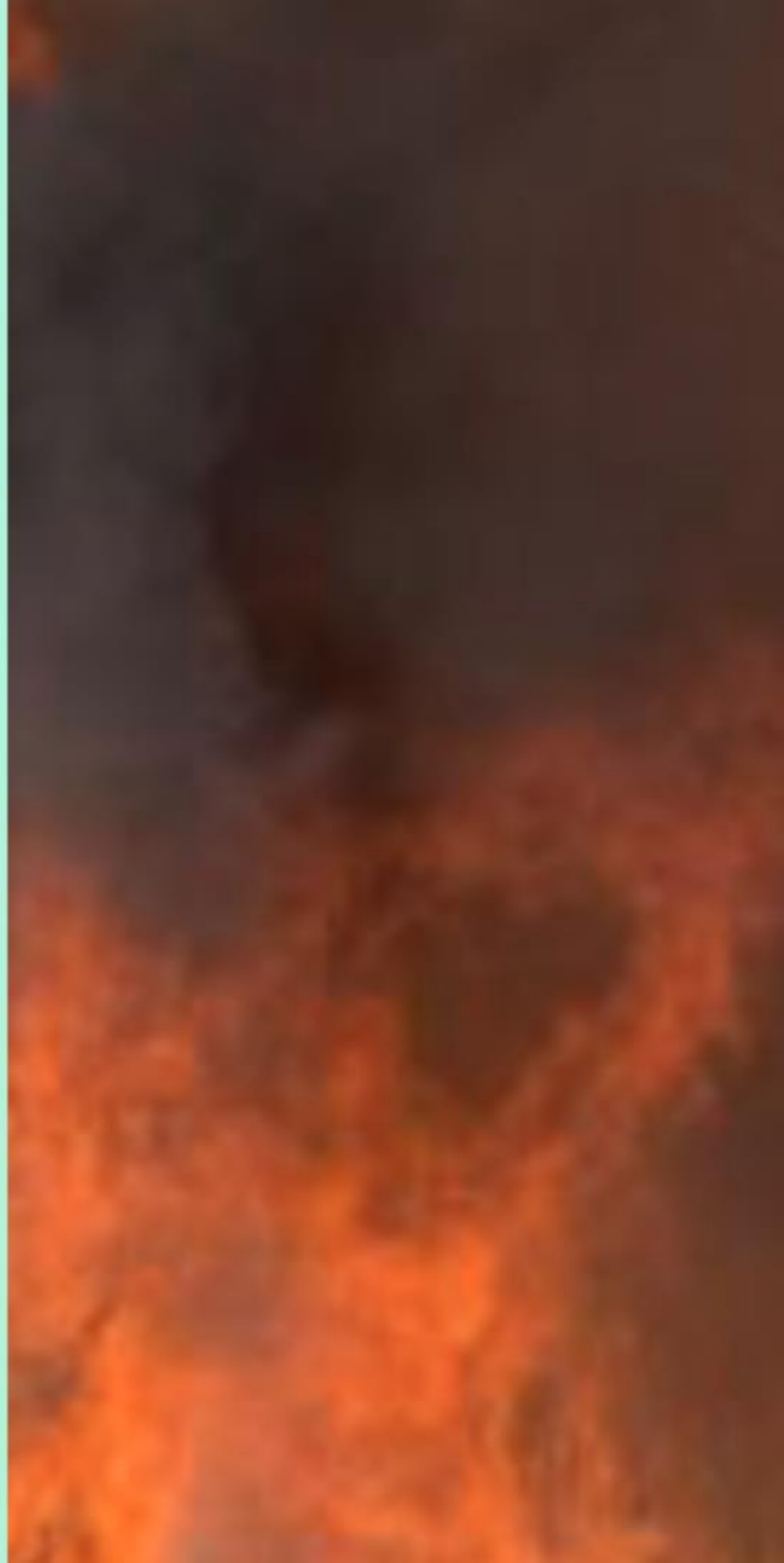


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STEPHEN CRANE

The Open Boat and Other Stories

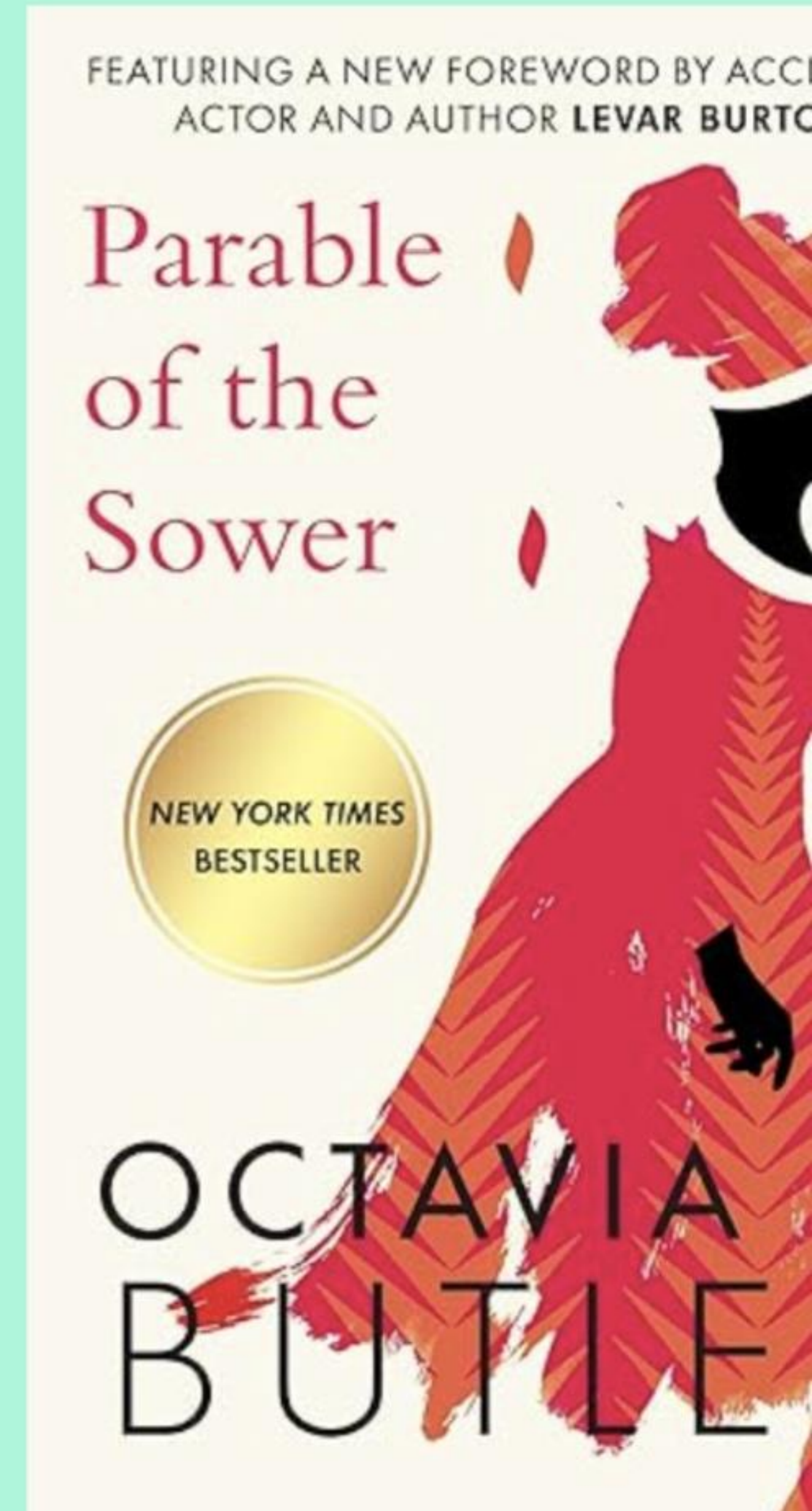




The Open Boat (Stephen Crane)

Nature is indifferent, not fair
Individuals face the same disaster
but experience it differently
Highlights gap between expectation
(fairness) and reality (random
survival)

→ Challenges the idea that nature
produces equal outcomes



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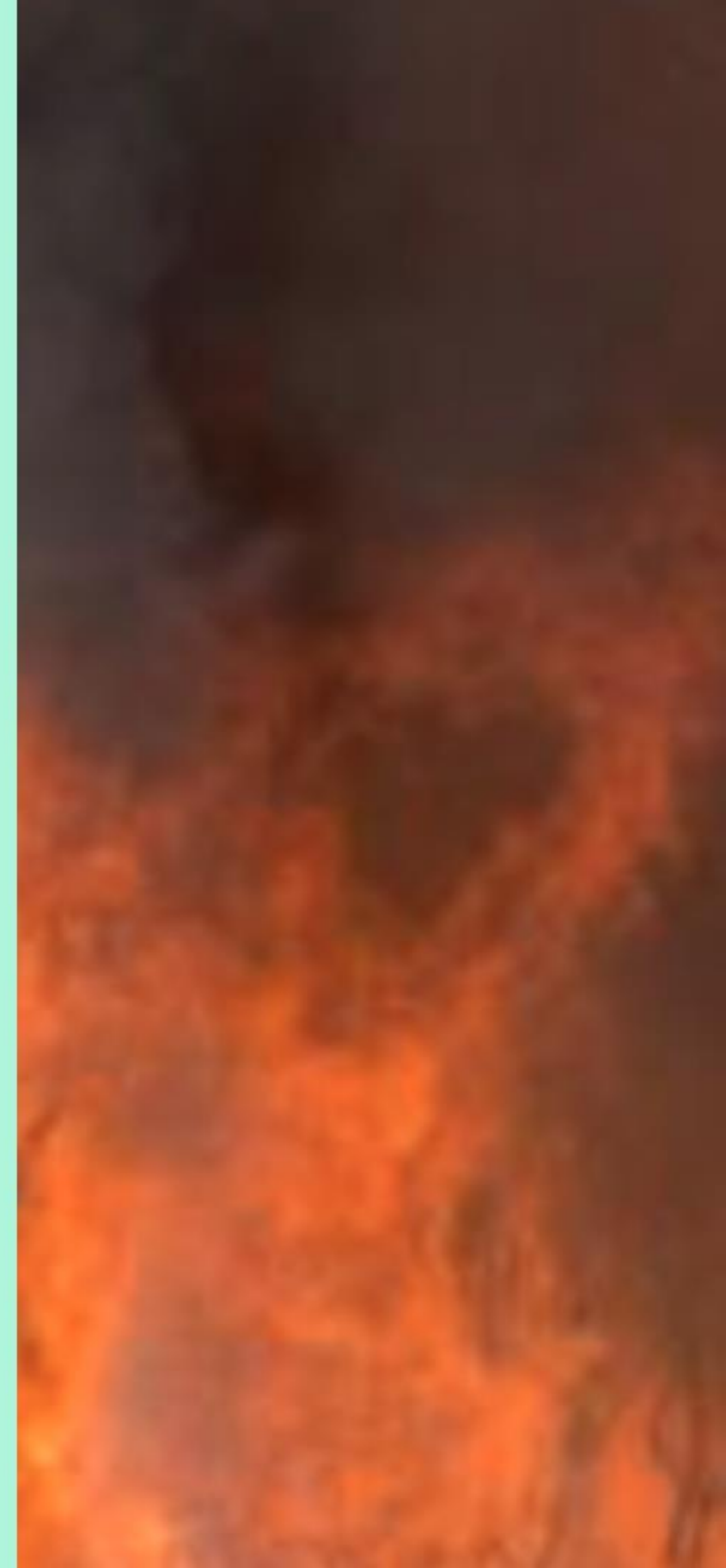


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Parable of the Sower (Octavia Butler)

Environmental crisis as an ongoing
condition, not a one-time event
Survival depends on resources,
mobility, and social position
Different characters → different
capacities to respond and recover

→ Inequality persists and deepens
over time



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Literature

Standard Migration



Wildfire Evidence



Inequality

→ **Out-migration ↑**
(Boustan et al., 2020; Ton et al., 2025)

Net migration flows ↓
(Winkler & Rouleau, 2021)

**Conditional / Mixed Effects
n-migration ↑**
(Gruber, 2022)

Short-run out-migration only
(McConnell et al., 2024)

Who lives in risky areas?
low-income: affordability
high-income: amenities
(Laszewski, 2024; Wibbemeyer & Robertson, 2022)

Inequality
Repeated exposure burden
(Hino & Field, 2023)

Literature

Insurance

→ **Financial constraints** ↑
(Boomhower et al., 2024; Keys
& Mulder, 2025)

Theory Only
Indirect Mechanism

Theory

- Standard Framework (Kennan & Walker, 2011)

$$Move_{it} = \begin{cases} 1 & \text{if } V_{ikt}^{move} > V_{izt}^{stay} \\ 0 & \text{if } V_{ikt}^{move} \leq V_{izt}^{stay} \end{cases}$$

- Budget Constraint

$$Y_i \geq C^{min} + H + I + R$$

- High-income households:

$$Y_H \geq C^{min} + H + I + R$$

→ Can remain (feasible)

- Low-income households:

$$Y_L < C^{min} + H + I + R$$

→ Constraint binds

DATA

Category	Description
Unit	ZIP × quarter panel (CA)
Period	2017q2 – 2023q1
Migration	USPS COA (net, in, out; per capita)
Wildfire	CAL FIRE (acres burned; p90 threshold)
Income	Census median income
Housing	Redfin housing prices

- Key advantage: High-frequency, ZIP-level variation

Regression Models (1)

- Baseline Two-Way Fixed Effects

$$Y_{it} = \beta WF_{it} + \alpha_i + \delta_t + \varepsilon_{it}$$

- Y_{it} :ZIP-level migration rate (net / in / out)
- WF_{it} :Wildfire exposure
- α_i, δ_t :ZIP and time fixed effects

Regression Models (2)

- Threshold Event Study (P90)

$$Y_{it} = \sum_{k=-4}^8 \beta_k \cdot \text{Event}_{i,t+k} + \alpha_i + \delta_t + \varepsilon_{it}$$

- Distributed Lag Model and Interaction

$$Y_{it} = \sum_{k=0}^8 \beta_k \ln(\text{WF}_{(i,t-k)}) + \sum_{k=0}^8 \gamma_k [\ln(\text{WF}_{(i,t-k)}) \cdot \text{High}_i] + \alpha_i + \delta_t + \varepsilon_{it}$$

Main Results (1-1)

Distributed Lag (Baseline)

	(1) Net total	(2) Net permanent	(3) In permanent	(4) Out permanent
Log intensity (t)	0.000040* (0.000021)	0.000013 (0.000019)	-0.000037** (0.000016)	-0.000046** (0.000020)
Lag 1	0.000006 (0.000024)	0.000018 (0.000018)	-0.000022 (0.000016)	-0.000038* (0.000020)
Lag 2	0.000008 (0.000021)	0.000010 (0.000018)	-0.000018 (0.000019)	-0.000024 (0.000019)
Lag 3	0.000015 (0.000022)	0.000024 (0.000018)	-0.000024 (0.000015)	-0.000045** (0.000019)
Lag 4	0.000007 (0.000023)	-0.000011 (0.000018)	-0.000017 (0.000016)	-0.000012 (0.000018)

Main Results (2)

Distributed Lag Effects (High-Income Interaction)

	(1) Net total	(2) Net permanent	(3) In permanent	(4) Out permanent
Log intensity	-0.000010 (0.000030)	-0.000046* (0.000027)	-0.000109*** (0.000021)	-0.000070** (0.000030)
Log intensity × highincome	0.000097** (0.000039)	0.000115** (0.000034)	0.000144*** (0.000027)	0.000050 (0.000032)
Lag 1	-0.000027 (0.000038)	0.000007 (0.000027)	-0.000068*** (0.000023)	-0.000073** (0.000031)
Lag 1 × highincome	0.000059 (0.000041)	0.000017 (0.000031)	0.000089*** (0.000028)	0.000071** (0.000035)
Lag 2	-0.000045 (0.000031)	-0.000038 (0.000026)	-0.000024 (0.000026)	0.000009 (0.000030)
Lag 2 × highincome	0.000104*** (0.000039)	0.000093*** (0.000034)	0.000000 (0.000033)	-0.000078** (0.000036)
Lag 3	-0.000001 (0.000034)	0.000021 (0.000029)	-0.000084*** (0.000022)	-0.000104*** (0.000033)
Lag 3 × highincome	0.000019 (0.000040)	-0.000002 (0.000033)	0.000097*** (0.000028)	0.000105*** (0.000037)

Discussion

- Wildfire exposure does not lead to mass out-migration
→ Instead, it creates a “mobility freeze”
- Migration is a constrained decision:
 - Economic: budget constraints, insurance burden
 - Humanities: constrained agency under environmental risk
- Tension between:
 - Migration pressure (higher cost of staying)
 - Migration feasibility (limited ability to move)
- Insurance market as a plausible mechanism:
 - Rising premiums, reduced coverage, insurer exit
- Limits both recovery
- Unequal impacts across groups:
 - Low-income → financially constrained, “trapped”
 - High-income → greater flexibility and adaptation
- Environmental risk produces uneven mobility outcomes
 - not everyone can respond in the same way, but inequality persists

Not Everyone Recovers from Disaster in the Same Way: Wildfire Risk, Insurance Premiums, and Income-Stratified Migration in California

Marine Kang

Background

- Natural disasters in the U.S. have increased substantially over time (Shover et al., 2020)
- Wildfires are becoming more frequent and intense, especially in California (Reiter & Souter, 2021; Williams et al., 2016)
- Order by:
 - Climate change (Brown et al., 2020; Williams et al., 2018)
 - Population growth & expansion into wildfire-prone areas (Reiter & Souter, 2021)
- Wildfires affect communities through:
 - Direct physical damage
 - Changes in local economic conditions (see occupational physician et al., 2022)

Research Question

- (1) How does wildfire exposure affect migration flows?
- (2) How do these patterns reflect deeper transformations in lived experience under environmental risk?

Humanities Cases

- Anthropology (Agustin et al., 2018)
 - Resilience of culture and identity
 - "Tatawuk" as a reconstructed belief
- Depositional (Demiro)
 - Connects fire history and materiality (geological, archaeology)
 - Migration as a historical through language, not "fixed reality"
- Social History (Hess, 2017)
 - Evolve racial bias and class inequality over time
 - Inequality based on ability to be affected by the event
- Culture, Trauma (Garcia, 2014; S. Miller, 2016)
 - Trauma narrative and history identity
 - Same event → different experiences across groups
- Environmental Justice (Bassett & Brown, 2017)
 - Environmental justice in fire risk reduction & policy
 - Vulnerable populations bear disproportionate burden

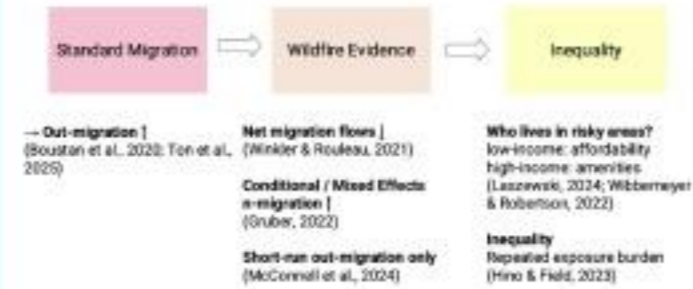


Humanities Framework

The Fire Risk Evidence to Read
Not just a scientific text, will be important to how the science dissemination is different. Highlights the scientific evidence that is not being captured in the text.

People of the Sun: The Fire Risk Evidence to Read
The historical and/or sociological context, not a new story about. Critical elements in research, methodology, and social position. Different characters in different responses to historical and current events.

Literature



Literature



Theory

- Standard Framework (Hino & Field, 2022)

$$M_{it} = \beta_0 + \beta_1 W_{it} + \beta_2 I_{it} + \beta_3 W_{it} \times I_{it} + \epsilon_{it}$$

- Budget Constraints: $\beta_1 < 0, \beta_2 > 0, \beta_3 < 0$
- High-income households: $\beta_3 > 0, \beta_2 < 0, \beta_1 < 0$
- Low-income households: $\beta_3 < 0, \beta_2 < 0, \beta_1 < 0$
- Low-income households: $\beta_3 < 0, \beta_2 < 0, \beta_1 < 0$
- Standard bias

DATA

Category	Description
Unit	ZIP + county-level ZIP
Period	2017Q1 - 2022Q1
Region	USPS DMA-level, in west part of US
Market	CA ZIPs (excludes border ZIPs)
Source	Demographic statistics (Census)
Missing	Health insurance

- Key advantage: High Frequency, ZIP-level variation

Regression Models (1)

- Standard Two-Way Fixed Effects: $Y_{it} = \alpha_i + \beta_t + \gamma_{it} + \epsilon_{it}$
- γ_{it} : ZIP-level migration response to risk
- α_i : ZIP-level amenity
- β_t : ZIP-level time fixed effects

Regression Models (2)

→ Theoretical-based model (Hino)

$$Y_{it} = \alpha_i + \beta_t + \gamma_{it} + \epsilon_{it}$$

→ Distributed Lag model interpretation

$$Y_{it} = \alpha_i + \beta_t + \sum_{k=0}^K \delta_k W_{it-k} + \epsilon_{it}$$

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