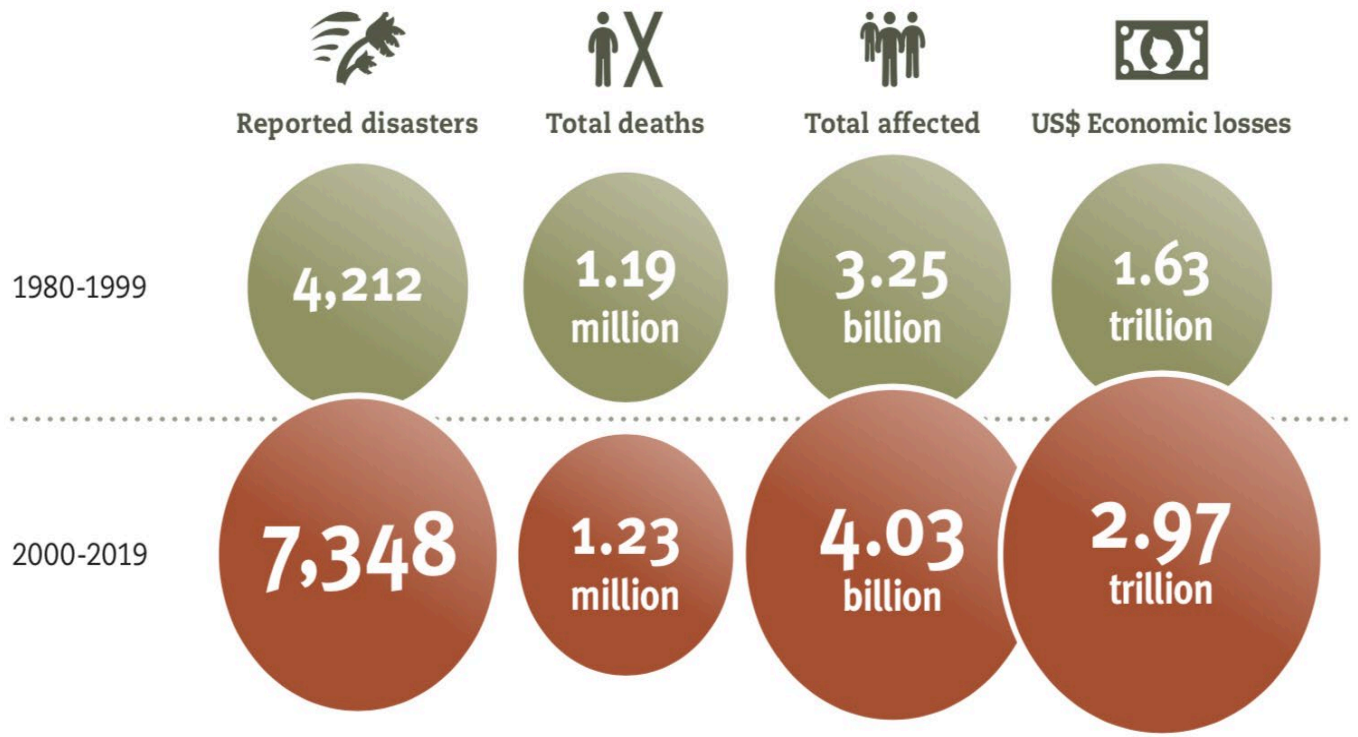
Costly disasters and the role of fiscal policy

Fabio Canova and Evi Pappa

BI and UC3M

Climate related disruptions have significant costs and their number increased over the last 20 years.

UN report "The Human Cost of Disasters 2000-2019"

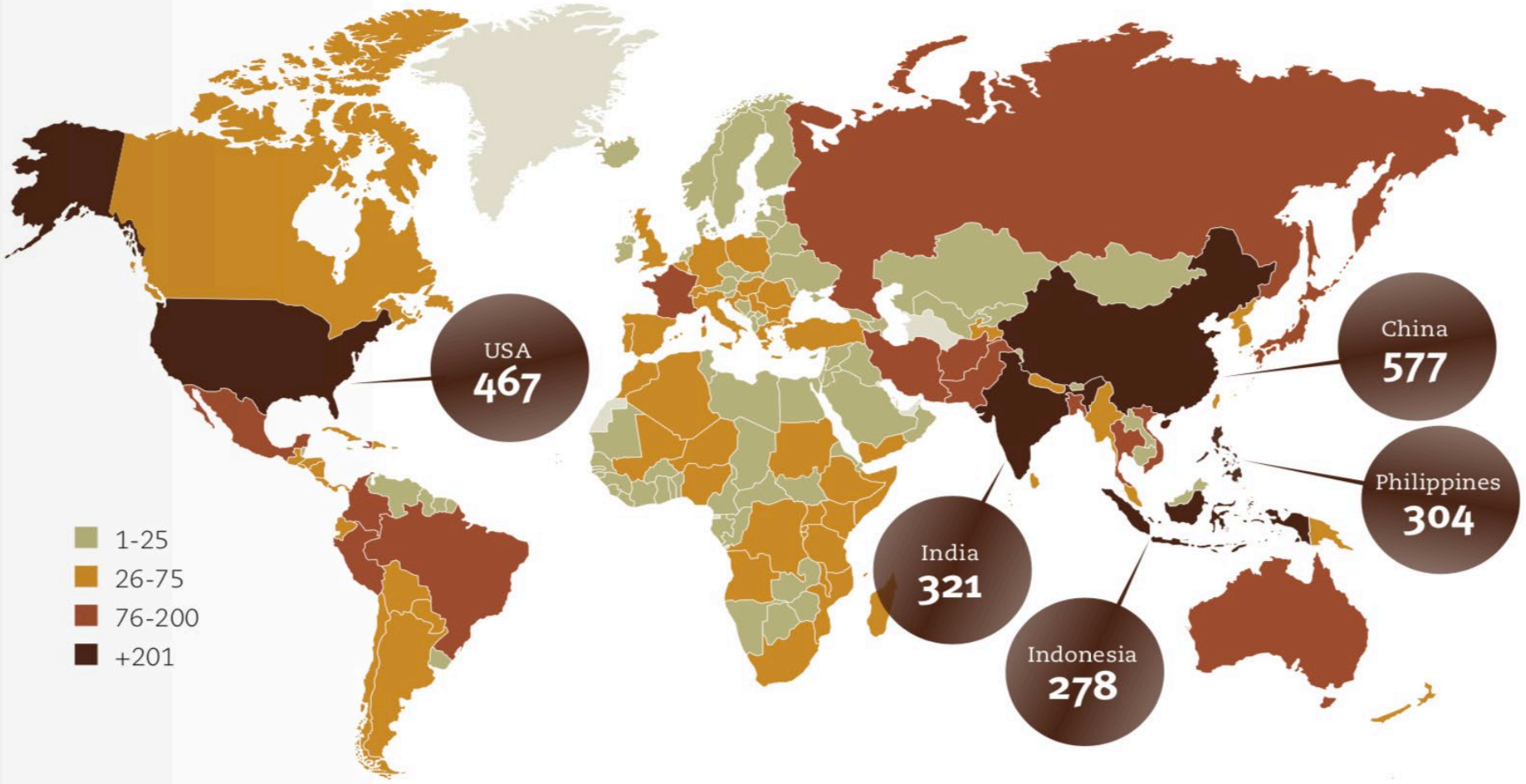


1 For the purposes of this report, the term "disaster" will only be reserved for natural hazard-related disasters, excluding biological and technological disasters.

2 All economic figures are adjusted to inflation for US$ 2019.

3 Climate-related disasters include disasters categorized as meteorological, climatological, or hydrological.

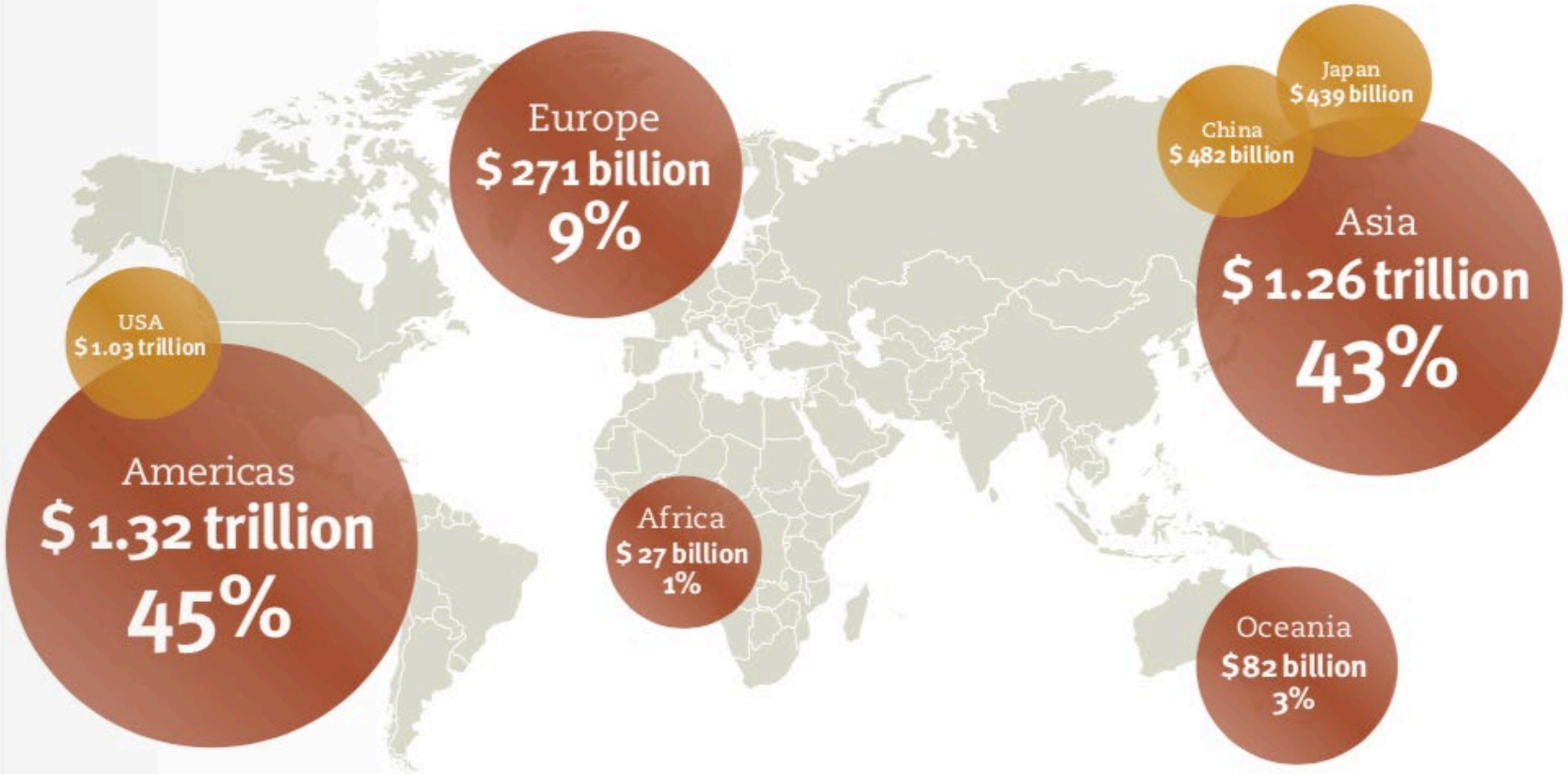
Reported disasters per country (2000-2019, UN report)



Total estimated costs (2000-2019, UN report)

Figure 18

Breakdown of recorded economic losses (US$) by continent (2000-2019)



Questions

Are there associated economic costs (output recessions, unemployment increases)? Are they more intense or more frequent in last few years?

How did (fiscal) policy respond? Did local debt increase? Were recessions shorter when fiscal policy was more pro-active?

Should there be pre-emptive actions? Special funds/suspension of budget rules for catastrophic events?

Similarities with COVID-19: large potential strain on fiscal balance.

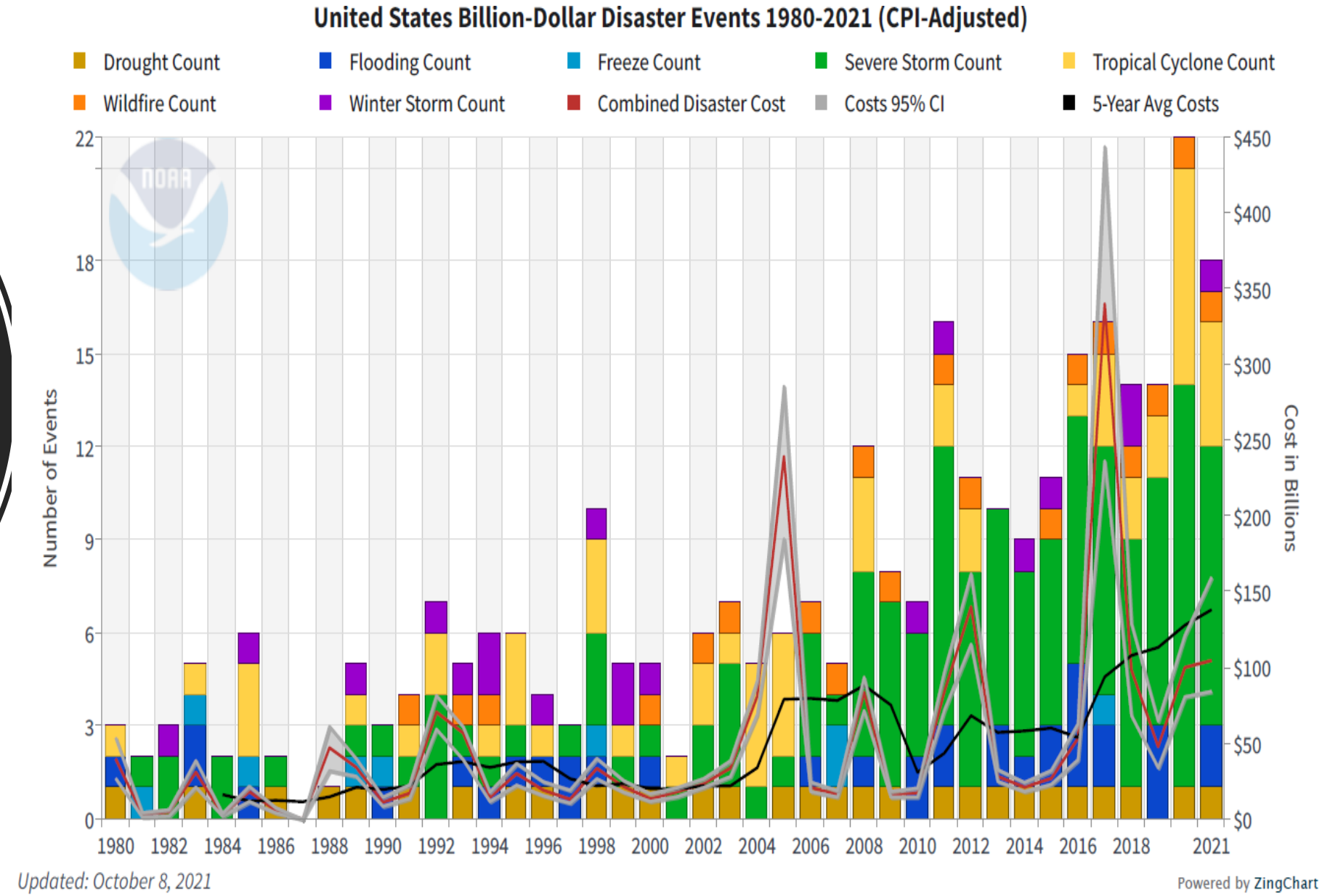
Contribution of the paper

- Examine effects of disasters on US state economies.
- Annual data: 1980-2018. Use macroeconomic and fiscal variables.

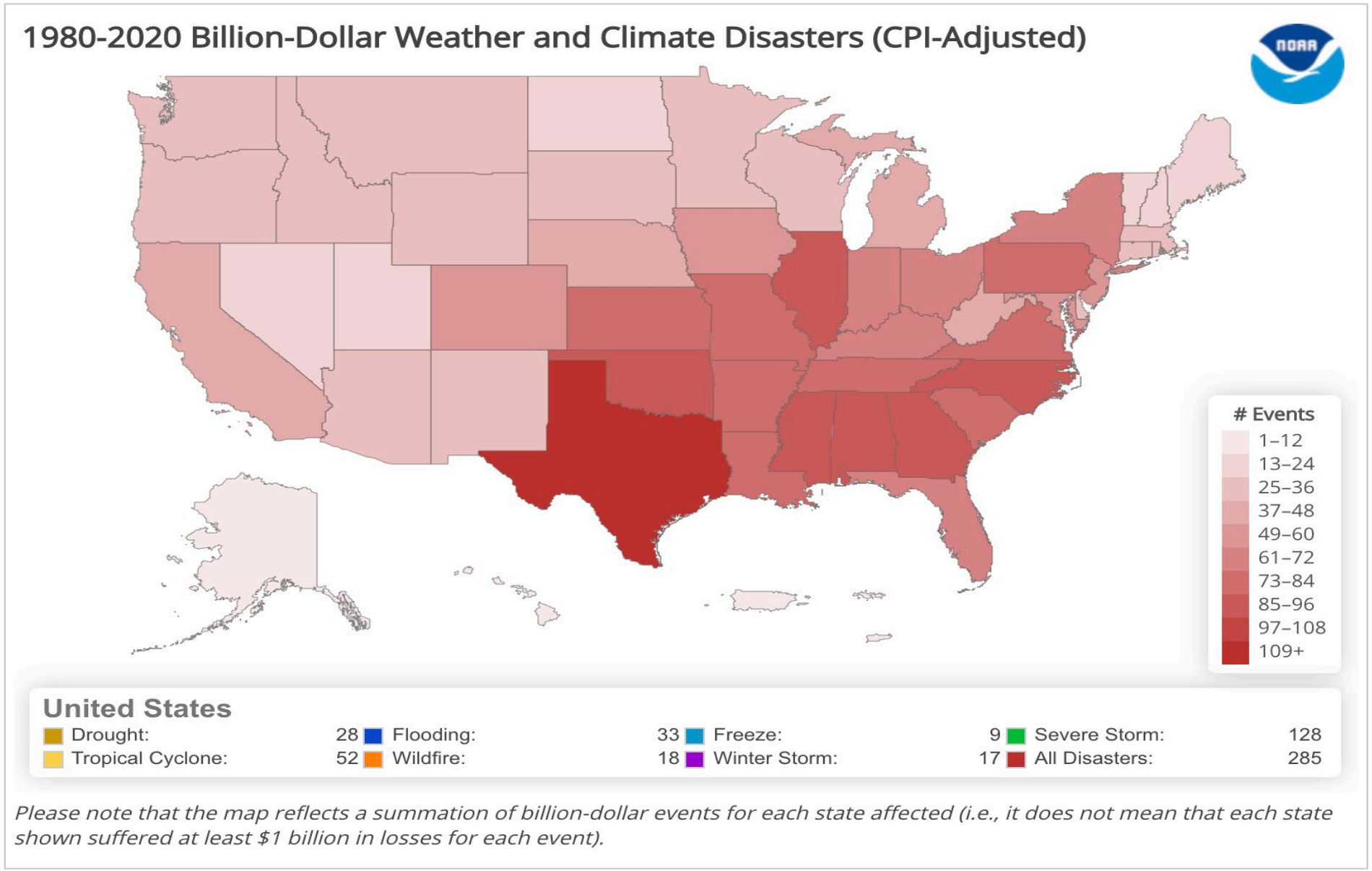
- **Event study exercise:** Evaluate the dynamics of macro and fiscal variables around disaster dates.
  - All events and separately by type of calamity, costs, location, year.
  - Focus on events generating recessions: what was the response of fiscal variables?

- **LP-IV exercise:** Analyze the transmission of disasters' cost shocks.
  - Study the effect of fiscal constraints and special budget provisions (RDFs).
  - Investigate the role of federal transfers/ state expenditure in containing the negative real effects of disasters.

National Oceanic and Atmosphere Administration, (NOOA) disaster data. Billion dollar events

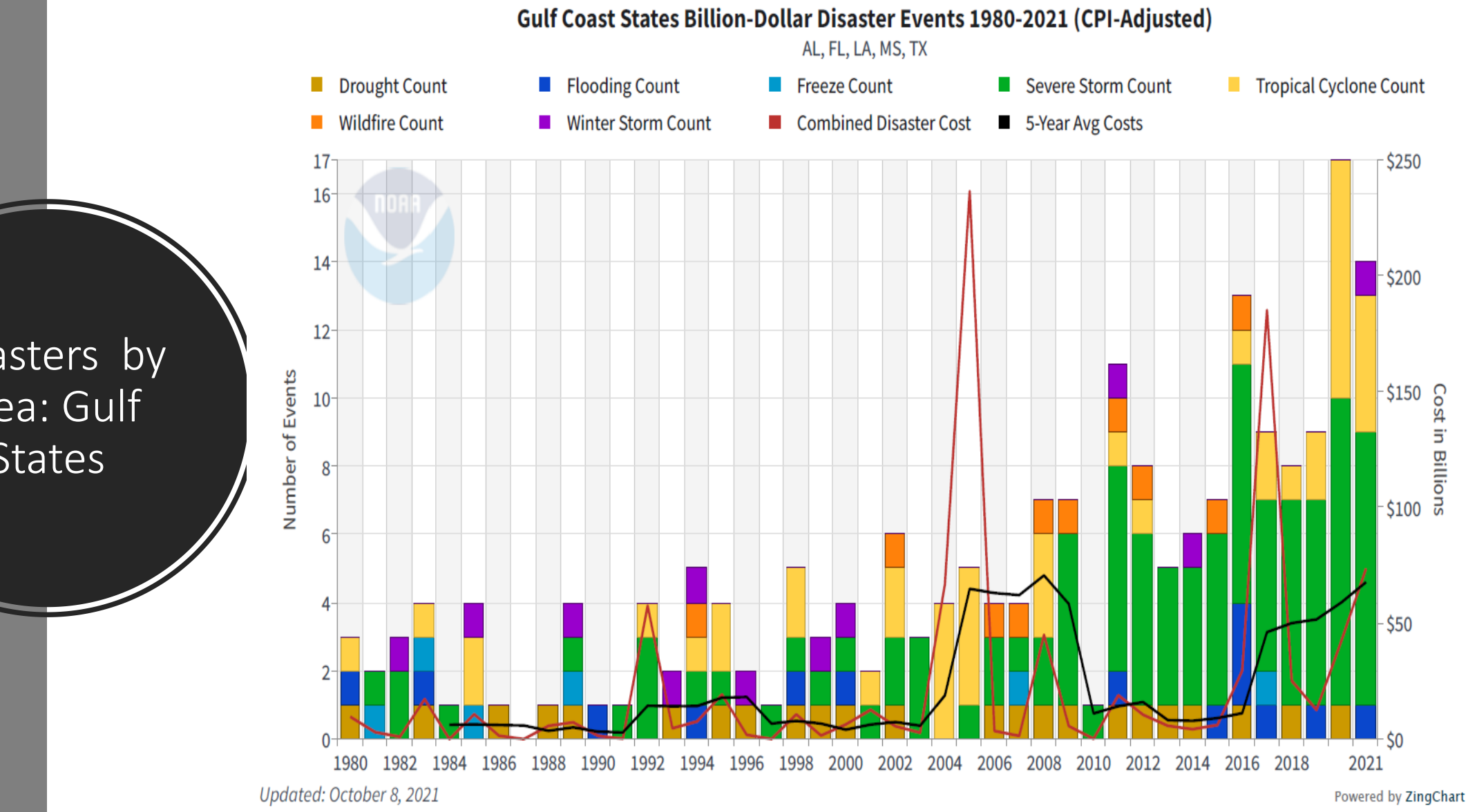


Geography of disasters

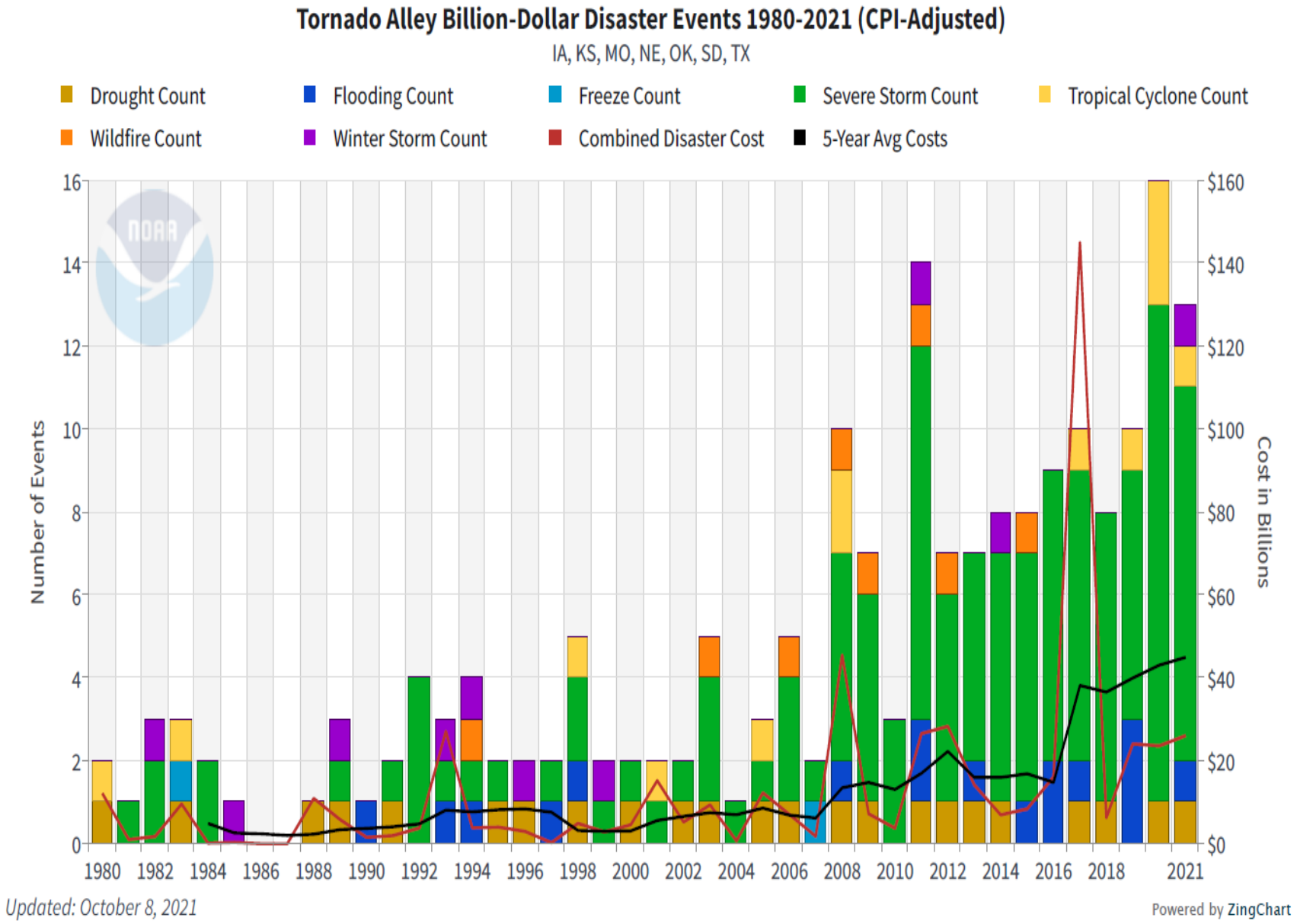


Please note that the map reflects a summation of billion-dollar events for each state affected (i.e., it does not mean that each state shown suffered at least $1 billion in losses for each event).

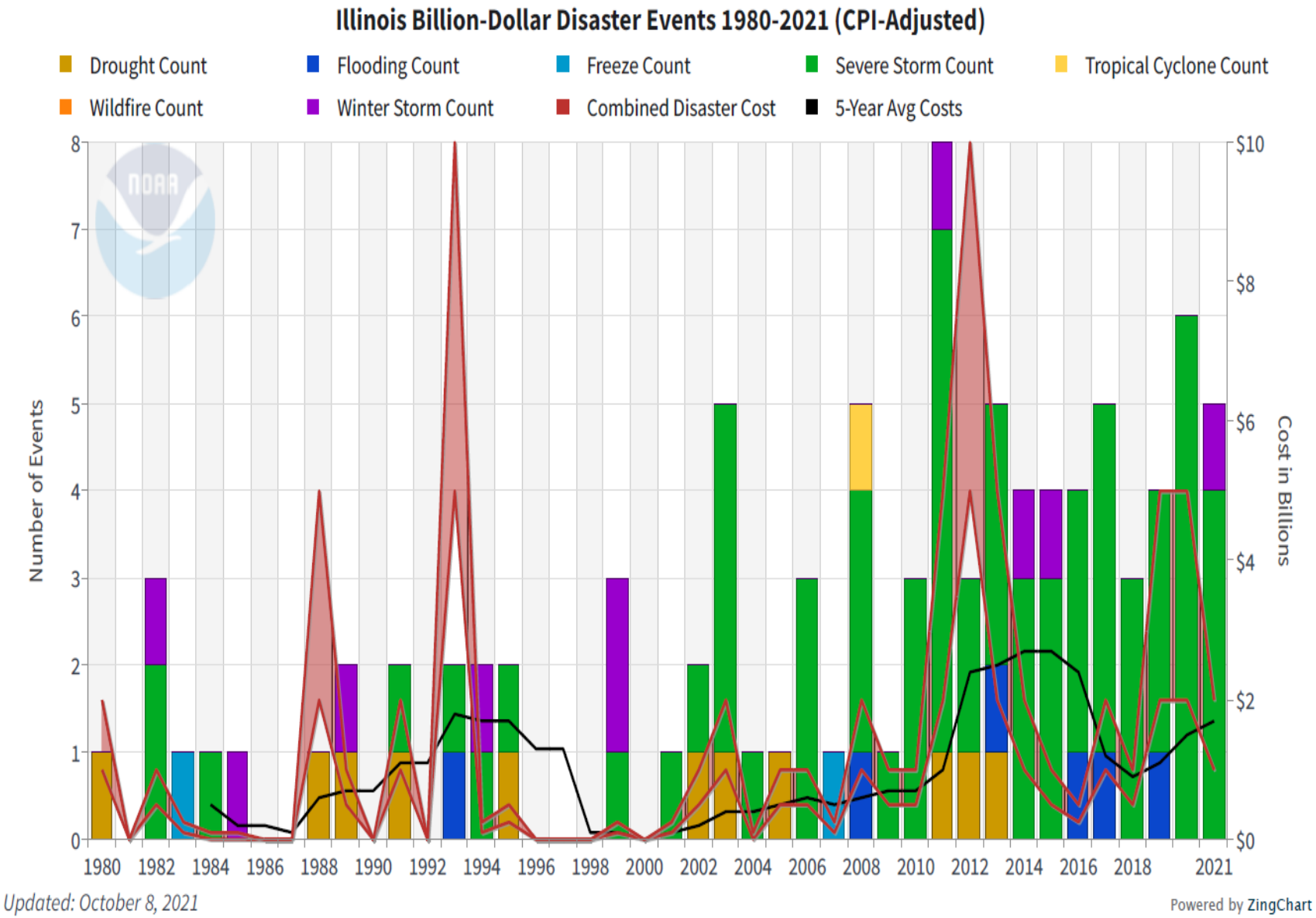
Disasters by area: Gulf States



Disasters by area: Tornado Alley



Disasters by state: Illinois



Disasters by state: California

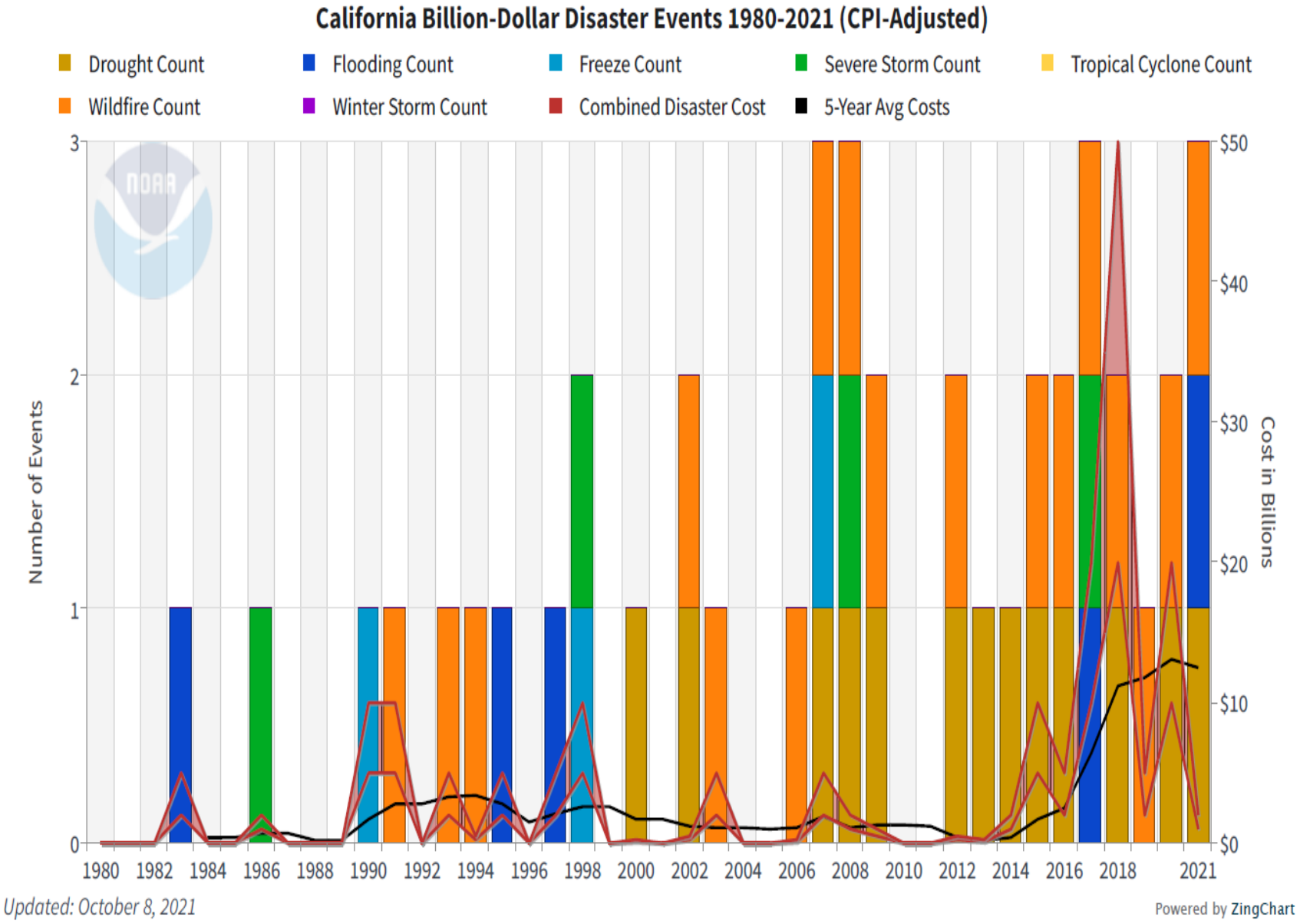


Table 1: Natural Disasters summary, 1980-2018

State	Number of disasters	Mean per capita costs	Major event
Alabama	80	411.6	Hurricane Katrina (2005)
Arizona	23	549.2	Severe Storm (2010)
Arkansas	62	104.8	Tornadoes (2011)
California	36	140.9	Wildfire (2018)
Colorado	47	285.5	Severe Storm (2018)
Connecticut	31	162.0	Hurricane Sandy (2012)
Delaware	26	415.5	Drought/Heatwave (2011)
Florida	56	686.9	Several Hurricanes (2004)
Georgia	80	149.2	Hurricanes Florence/Michael (2018)
Hawaii	1	8696	Hurricanes Iniki (1992)
Idaho	25	365.7	Drought/Heatwave (1988)
Illinois	76	154.8	Drought/Heatwave (2012)
Indiana	62	241.6	Flood (2008)
Iowa	50	798.7	Flood (1993)
Kansas	68	507.2	Drought/Heatwave (2012)
Kentucky	62	231.1	Drought/Heatwave (2012)
Louisiana	63	2063.2	Hurricane Katrina (2005)
Maine	14	267.7	Winter Storm (1998)
Maryland	54	158.3	Hurricane Ivan (2003)
Massachusetts	27	91.4	Hurricane Bob (1991)
Michigan	34	55.4	Drought/Heatwave (1988)
Minnesota	33	390.2	Flood (2008)
Mississippi	72	1013	Hurricane Katrina (2005)
Missouri	71	344.8	Severe Storm (2011)
Montana	27	1363	Drought/Heatwave (1988)
Nebraska	39	712.6	Drought/Heatwave (2012)
Nevada	18	170.2	Flood (1997)
New Hampshire	16	307.6	Winter Storm (1998)
New Jersey	44	327.1	Hurricane Sandy (2012)
New Mexico	27	223.6	Hurricane Dolly (2008)
New York	59	140.8	Hurricane Sandy (2012)
North Carolina	78	307.3	Hurricanes Florence/Michael (20118)
North Dakota	17	3707	Drought/Heatwave (1988)
Ohio	62	83.6	Hurricane Ike (2008)
Oklahoma	75	387.8	Severe Storms (2013)
Oregon	30	132.7	No major event
Pennsylvania	66	76.4	Hurricanes Ivan/Jeanne (2004)
Rhode Island	23	320.9	Hurricane Sandy (2012)
South Carolina	66	432.4	Hurricane Hugo (1989)
South Dakota	24	1317	Drought (2006)
Tennessee	72	218.6	Severe Storm (2003)
Texas	106	514.0	Hurricane Harvey (2017)
Utah	18	248.8	Flood (1983)
Vermont	15	731.7	Hurricane Irene (2011)
Virginia	71	142.5	Hurricane Isabel (2003)
Washington	25	67.6	Drought/Heatwave (2015)
West Virginia	34	294.4	Flood(1988)
Wisconsin	31	159.7	Flood (1993)
Wyoming	21	94.9	Drought/Heatwave (1988)

State level macro data

Regional Economic Accounts, BEA, 1997-2019

- GSP : State counterpart of national GDP, including industries' contributions to each state economy.
- GSP deflator
- State Population

- **Regional Unemployment Statistics, BLS, 1997-2021**
- Unemployment rate by State

- Integrate with data from Canova and Pappa (2006)
- Final sample: 1980-2019.

State and local government data 1980-2017 U.S. CENSUS BUREAU PUBLICATIONS ON GOVERNMENT FINANCES

- **General Expenditure**. All government expenditure other than the specifically enumerated kinds of expenditure classified as *Utility Expenditure, Liquor Stores Expenditure, and Employee-Retirement* or other *Insurance Trust Expenditure*.

- **General Revenue**. All government revenue except *Liquor Stores Revenue, Employee Retirement, Insurance Trust Revenue*, and *Utility Revenue*.

- **Debt**. All **long-term** credit obligations of the government and its agencies whether backed by the government's full faith and credit or nonguaranteed, and all interest-bearing **short-term** credit obligations.

- **Intergovernmental Revenue**. Amounts received from other governments as fiscal aid in the form of shared revenues and grants-in-aid, as reimbursements for performance of general government functions and specific services for the paying government (e.g., care of prisoners or contractual research), or in lieu of taxes. Excludes amounts received from other governments for sale of property, commodities, and utility services.

- **Intergovernmental Revenue From Federal Government**. Intergovernmental revenue received by a government directly from the Federal Government. For local governments, excludes Federal aid channeled through state governments, which is considered as *Intergovernmental Revenue from State Government*.

- **Public Welfare Expenditure** . Support and assistance to needy, contingent upon their need. Excludes pensions to former employees and other benefits not contingent on need.

Event study exercise

Trace the distribution over time of state macro variables (scaled by the US average, normalized by pre-desastr level) around disaster dates:

All events

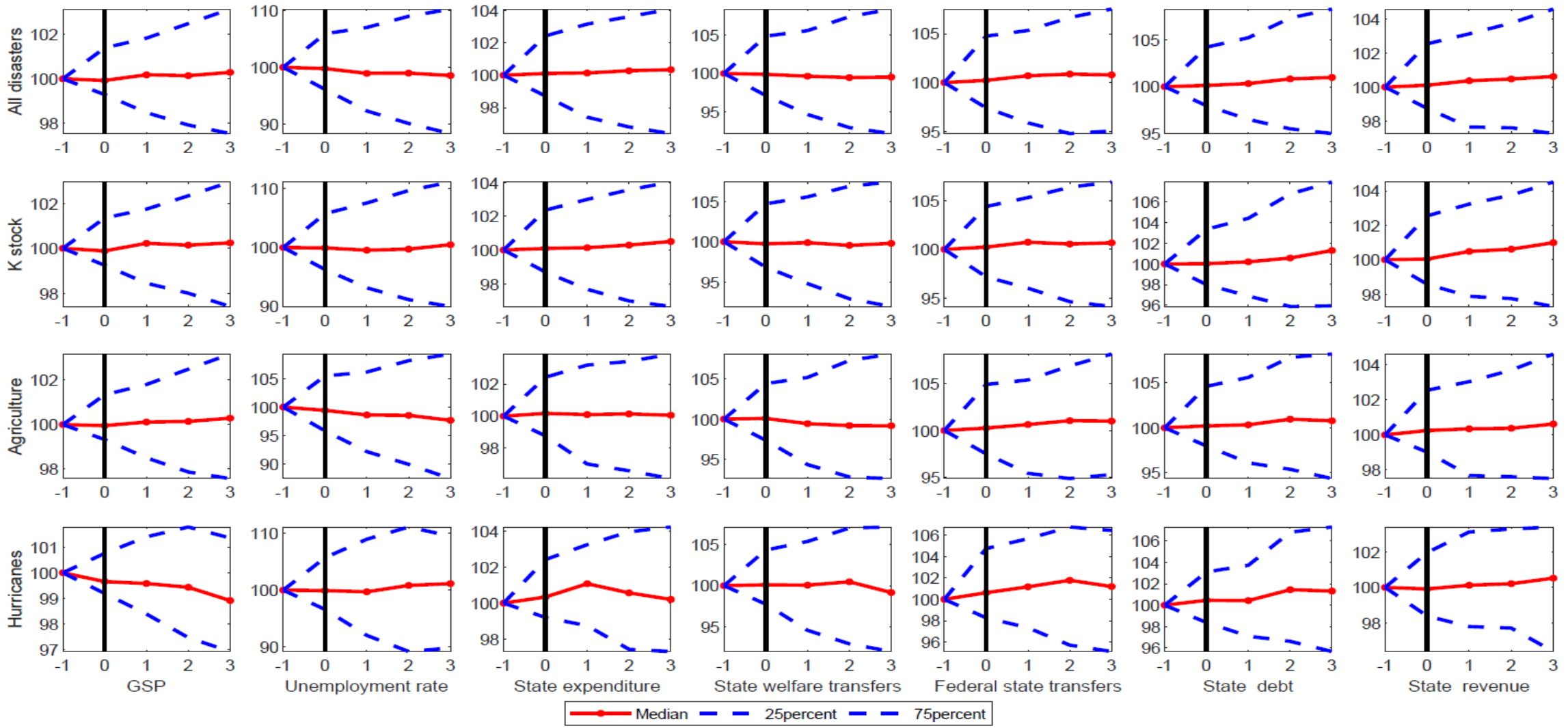
Events destroying K stock, affecting agriculture, tropical cyclones.

Costly events: more than 2200 dollars per capita or more than 5% of GSP (32/33 episodes).

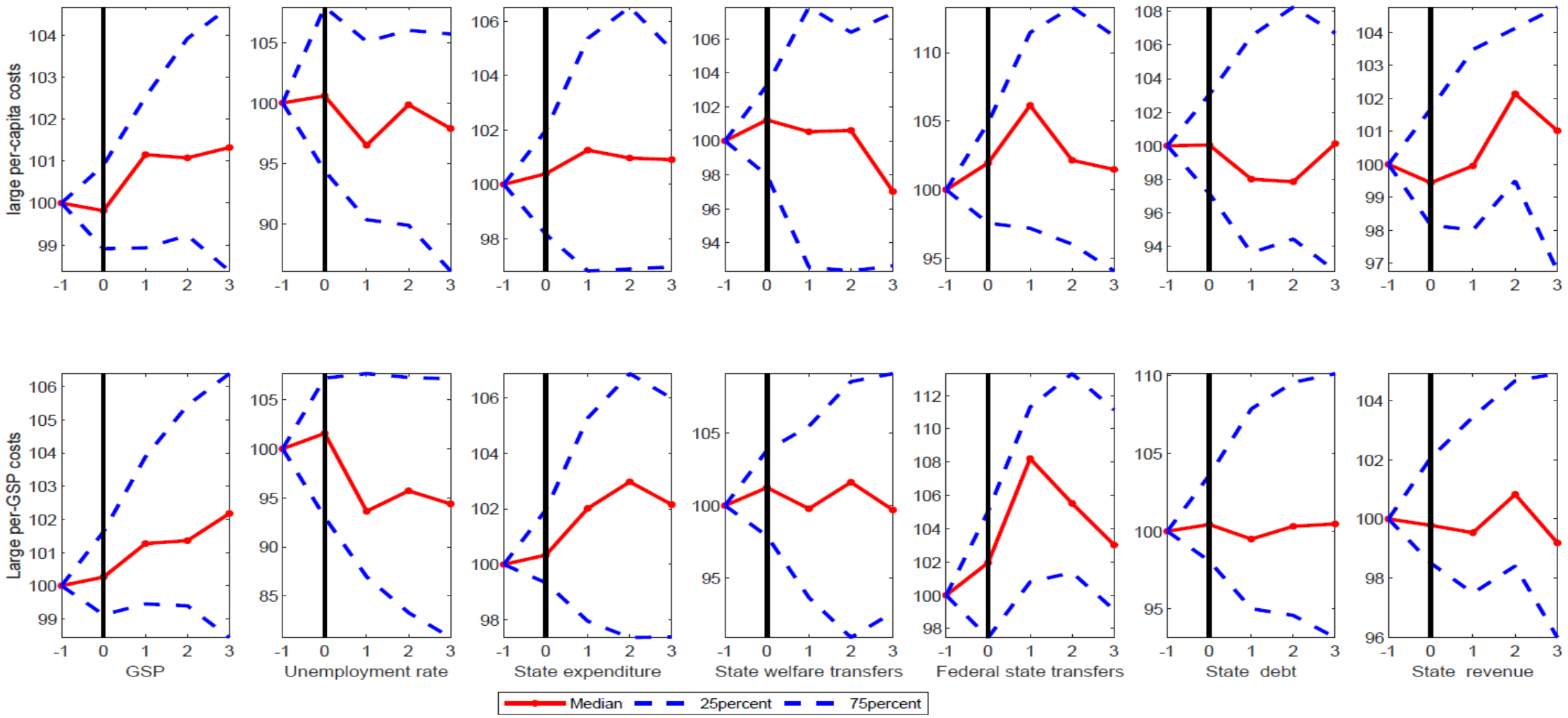
Eents occurring in years with more than 10 calamities (1998, 2008, 2011-2013, 2015-2017).

Southeast region (Gulf region)

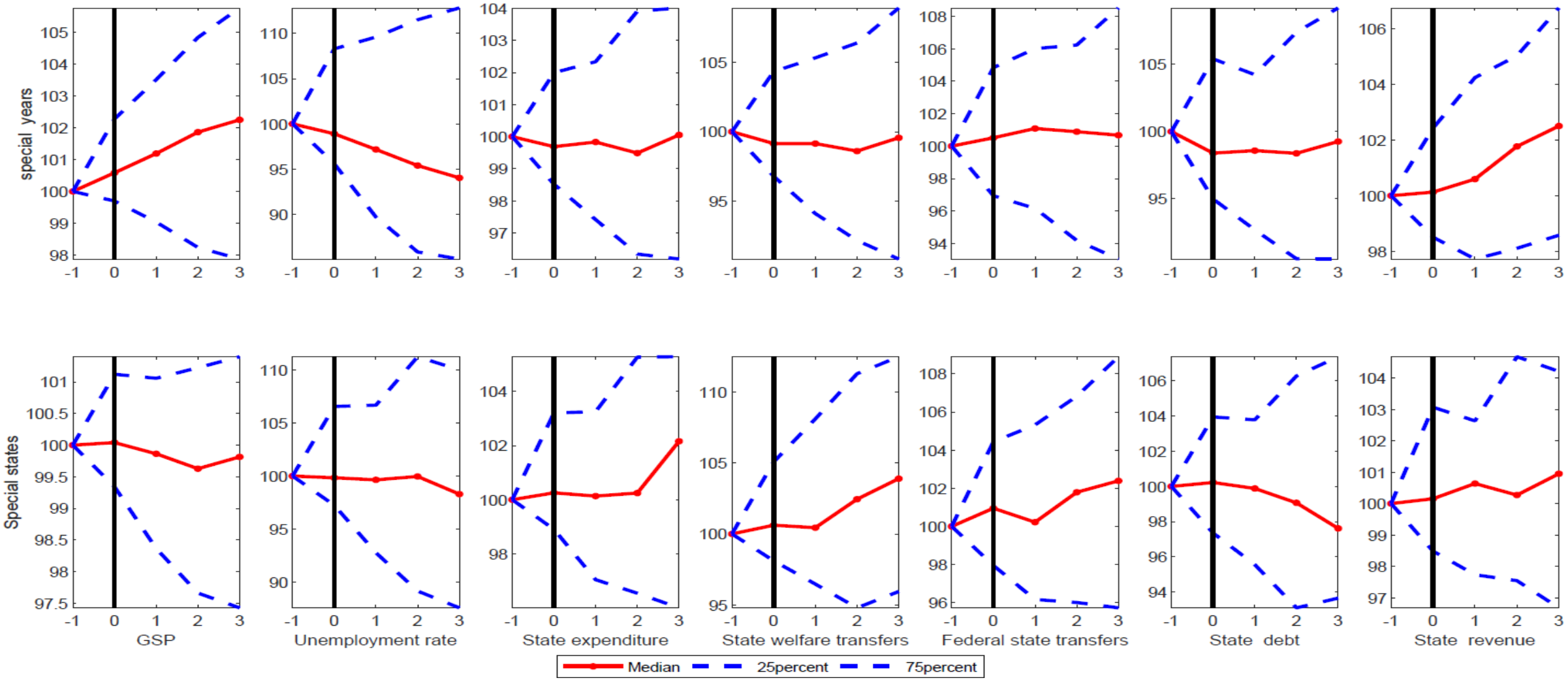
All events and by type



Events with large Costs



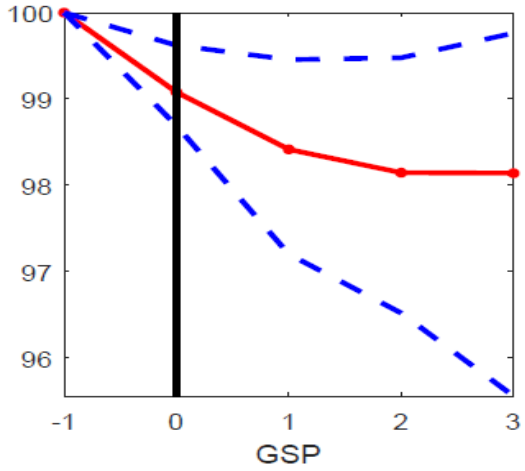
Events at special times and special location

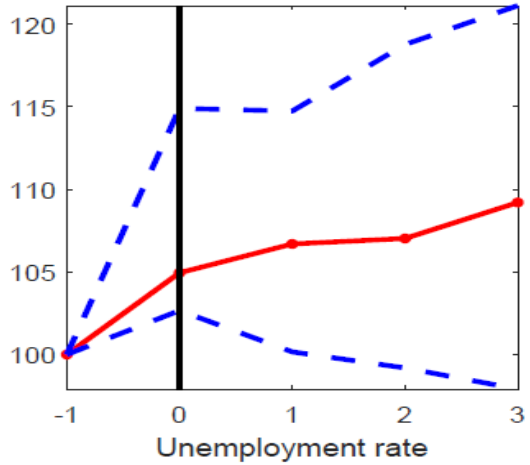


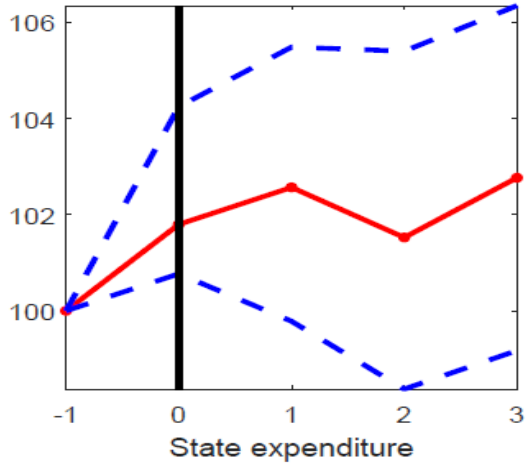
Large dynamic macro heterogeneity following disasters. Unrelated to:

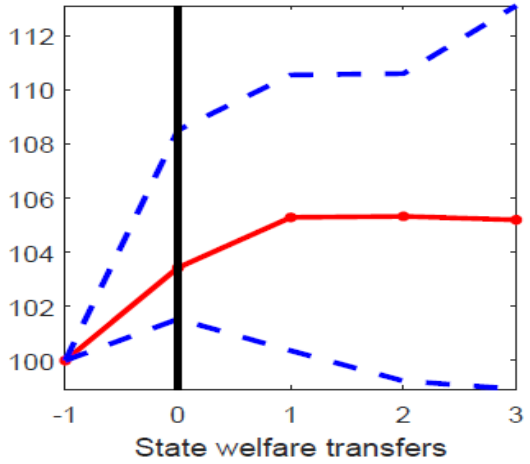
- The type of events.
- The costs.
- The intensity of the phenomena.
- Geography.
- Where do we go from here? Supervised (reverse engineering) exercise.

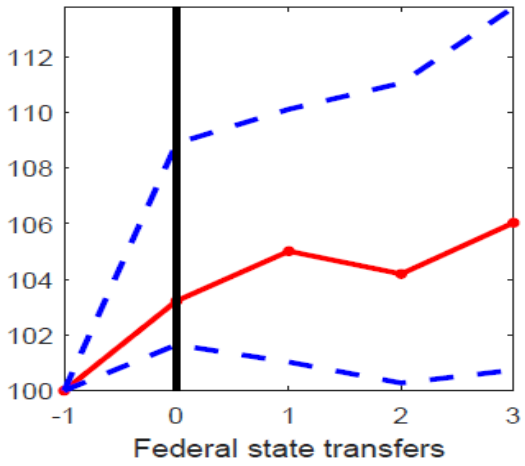
Events generating a gsp recession in year 0

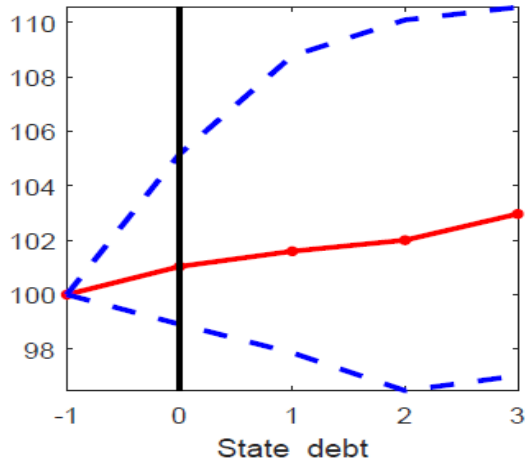


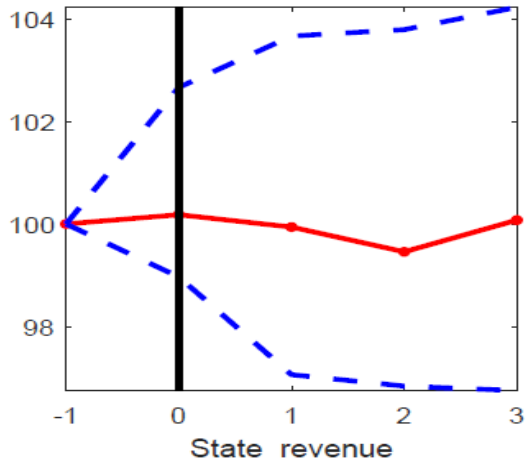


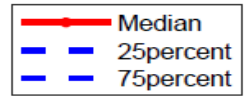




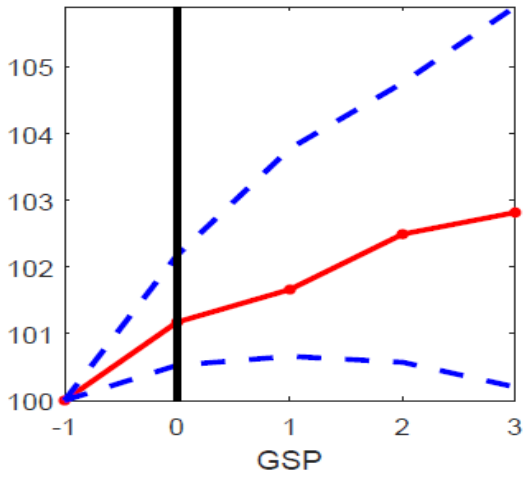


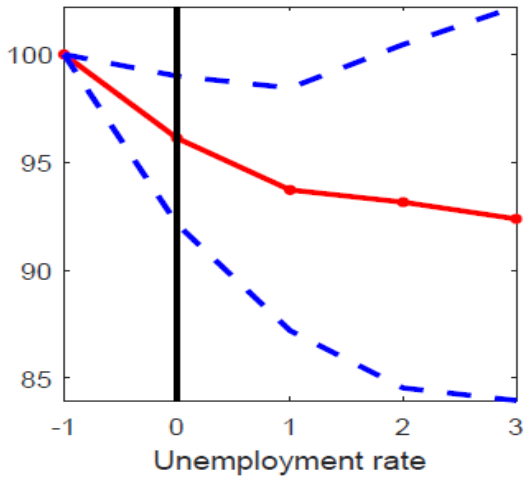


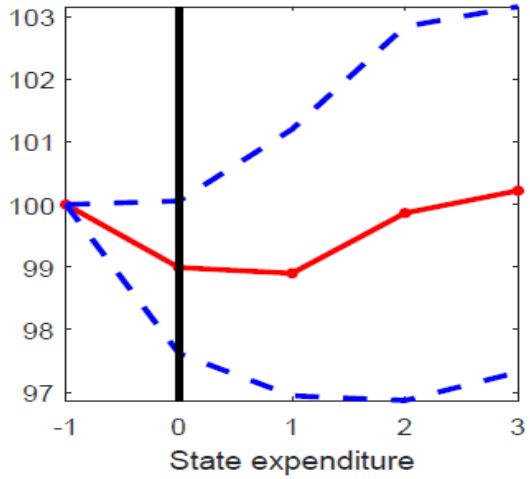


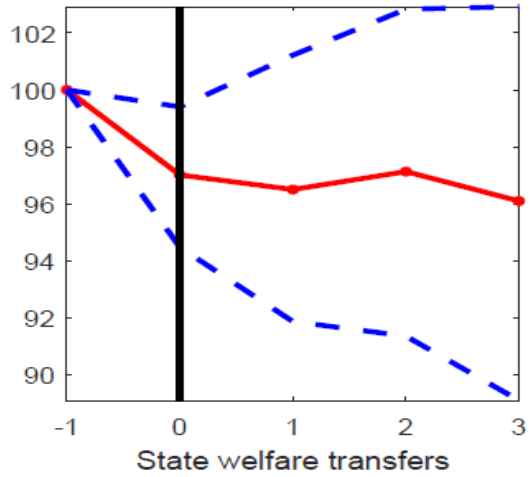


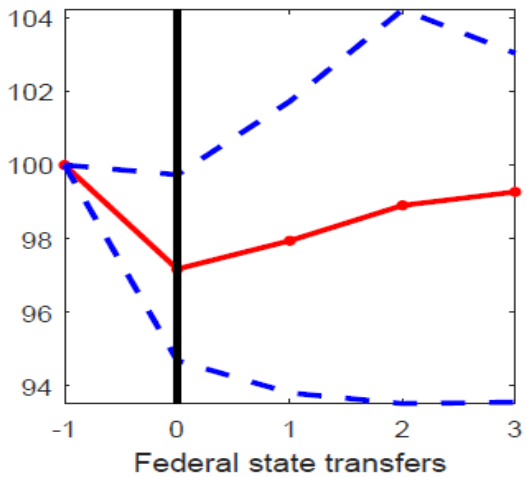
Events generating a gsp expansion in year 0

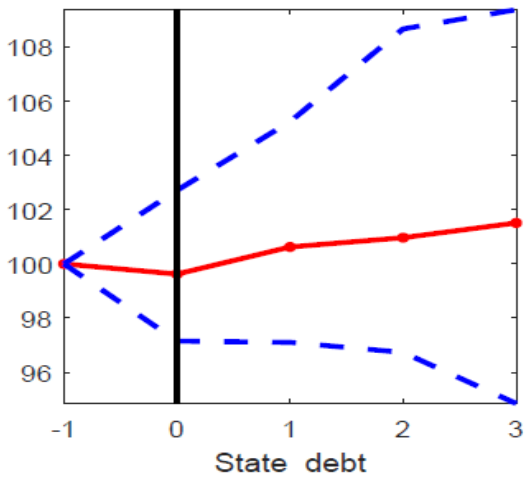


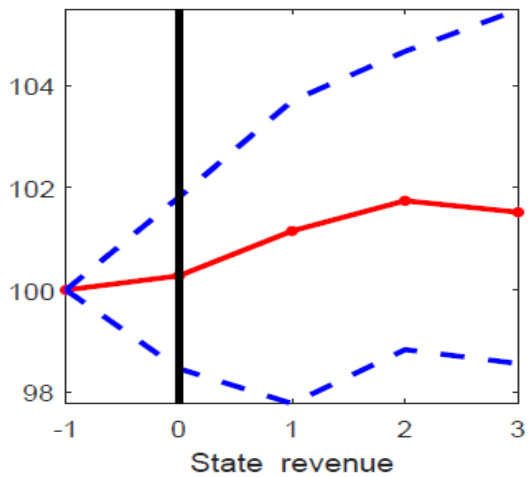


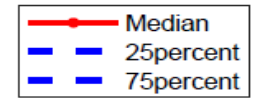




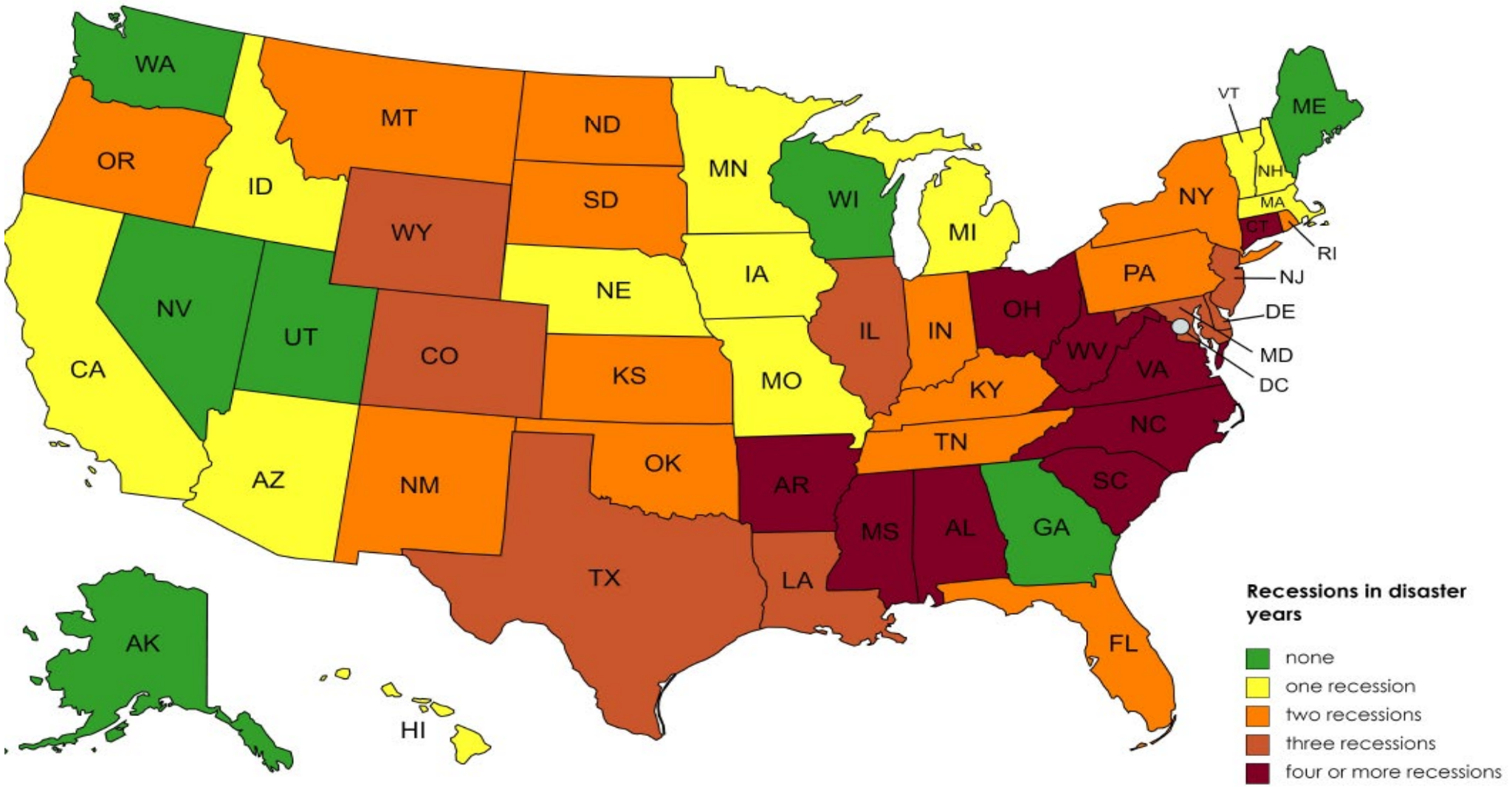




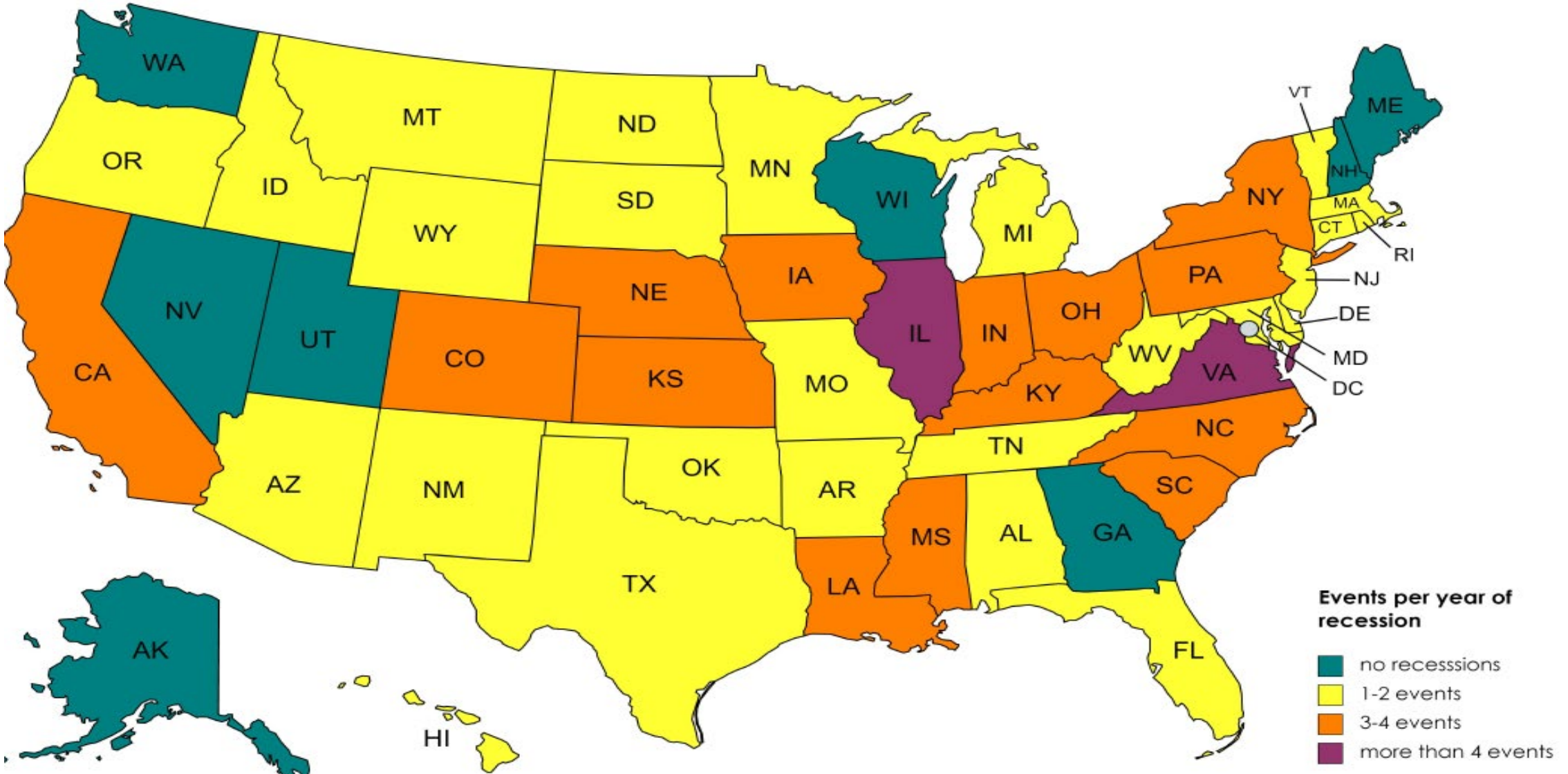




Distribution of recessions by states



Average number of catastrophic events per recession



Preliminary conclusions

- Disasters do not generate clear dynamic patterns for macro and fiscal variables.
- Heterogeneity not related to type of events, costs, location, or the year.
- If a recession is created, state and federal fiscal variables respond. Federal transfers more sensitive and more persistent than of state fiscal variables.
- No clear path for debt. Median tends to increase.
- Difficult to characterize the mix generating a recession using disaster characteristics (cost, location, type).

Problems with event -studies

- Unsupervised methodology makes a number of (incorrect) assumptions:
  - All events receive the same weight in the computations.
  - All events are treated as iid in time and space.

- Supervised methodology gives different weights but still treat events as iid in time and space. State characteristics (economic structure, experience with previous disasters, etc.) disregarded.

- Timing of the event may differ (winter storms vs. tropical cyclones). Effects maybe confounded because of timing differences (see Sun and Abraham, 2020).

- Event studies measure unconditional correlations around disaster dates. Other events may occur in a disaster year. Can’t discuss causation.

Local projection exercise

Investigate the responses of state macro variables (scaled by the US average) to a **disaster cost shock**:

All events, state by state.

Zoom in on individual states.

Group responses by income, fiscal restrictions, existence of rainy days funds.

Group responses by high /low reaction of state expenditude / federal transfers.

The econometric model

- Basic regression:

$$y_{i,t+h} = a_{i,h} + c_{i,h}w_{i,t-1} + b_{i,h}y_{i,t-1} + d_{i,h}x_{i,t} + e_{i,t+h}$$

$i =$ state, $t =$time, $h =$horizon; $y_{i,t,h}$, variables of interest (scaled relative US average); $x_{i,t}$ is the disaster per-capita cost at time t for state i; $w_{i,t-1}$ are controls (at least, scaled state output, scaled state unemployment).

- Instruments: $(1, w_{i,t-1,h}, y_{i,t-1}, u_{i,t})$.

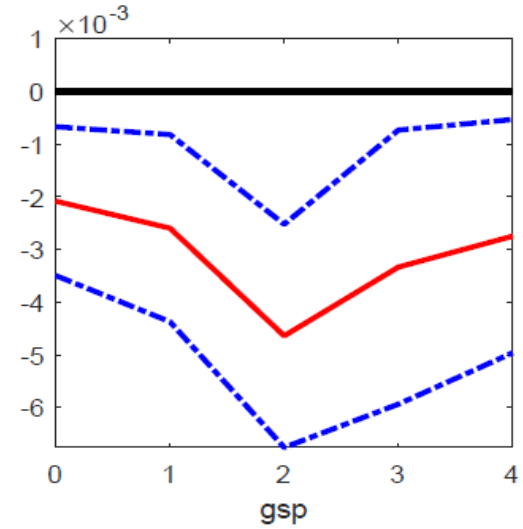
- $u_{i,t}$ obtained from ($x_t =$factor):

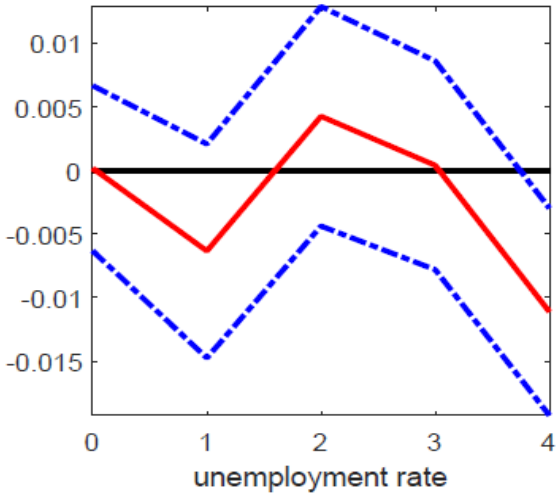
$$x_{i,t} = \alpha_i + \beta_{1i}x_{it-1} + \beta_{2i}x_t + u_{i,t}$$

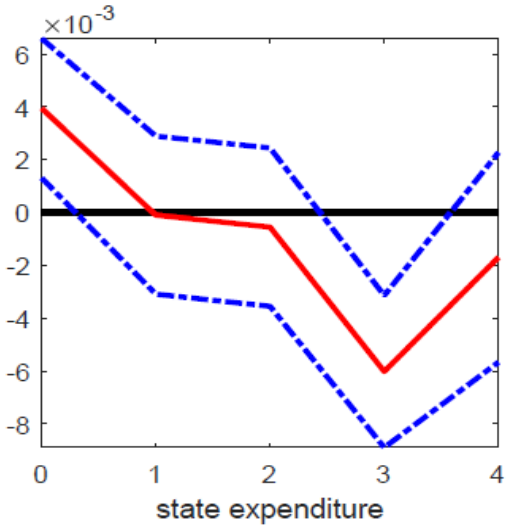
- Normal prior on ($a_{i,h}$, $b_{i,h}$, , $c_{i,h}$, $d_{i,h}$) with zero mean and fixed variance (IV ridge estimator).

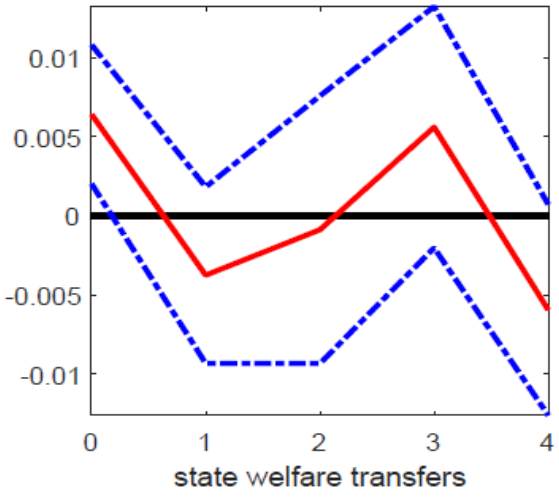
- Use a diffuse prior on (α_i, β_i)

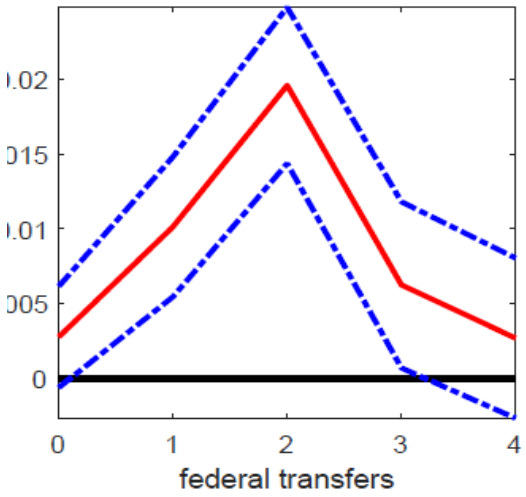
Responses to disaster cost shocks, per-capita costs

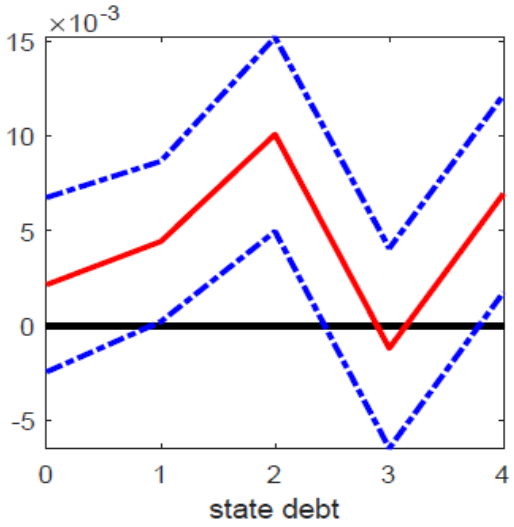


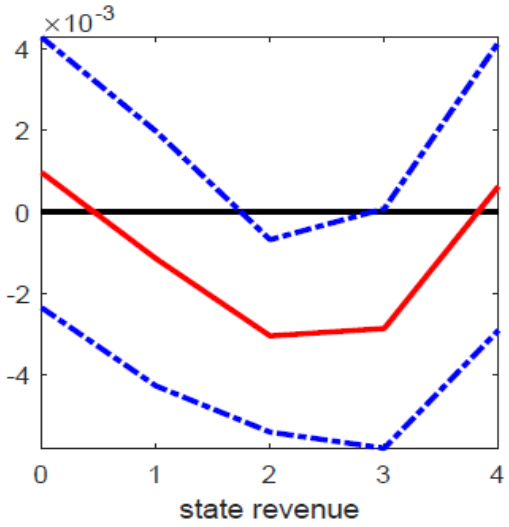


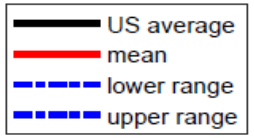




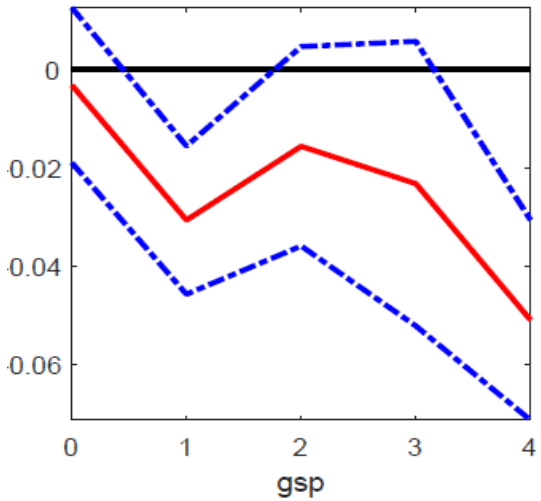


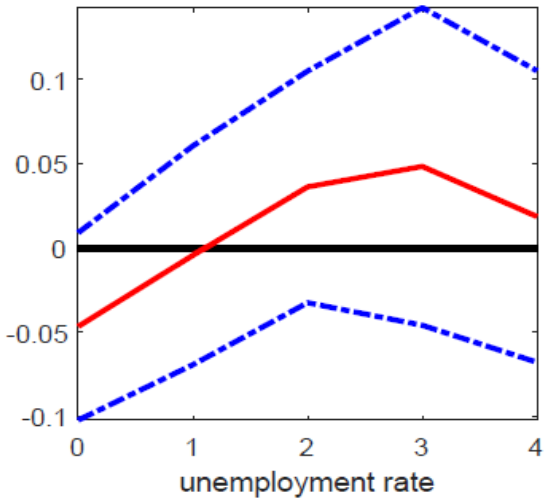


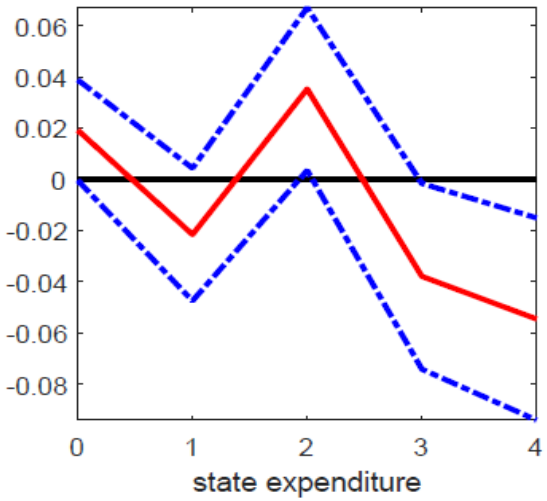


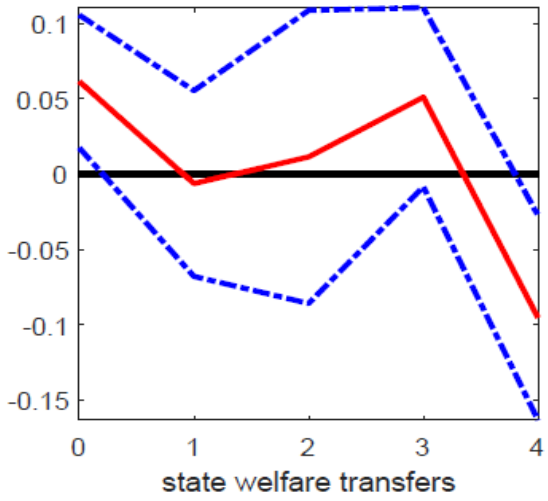


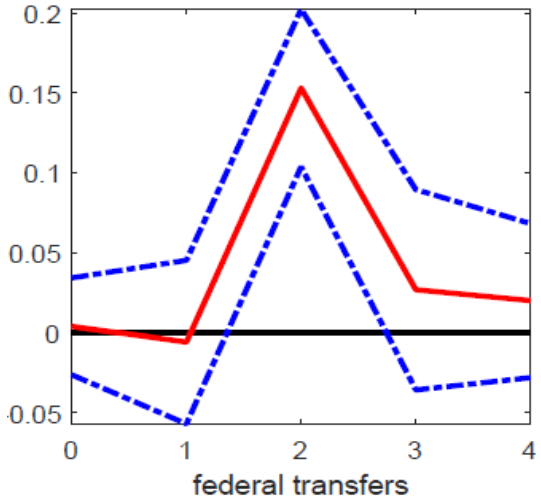
Responses to disaster costs shocks, per-GSP costs

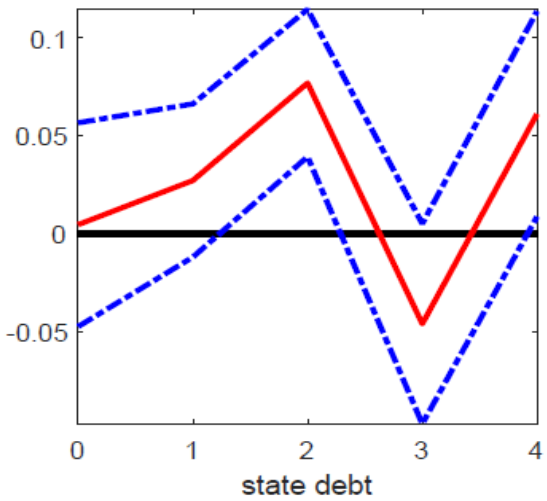


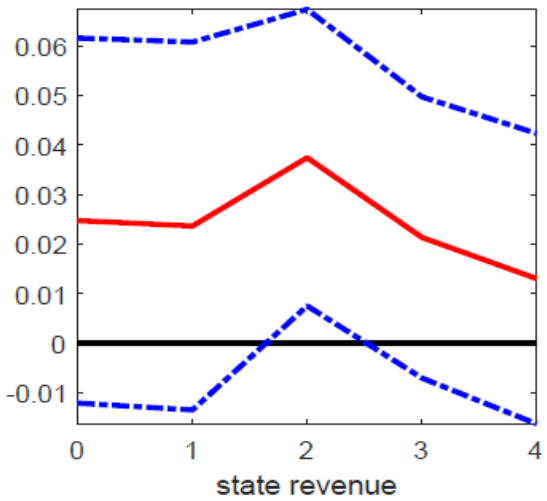


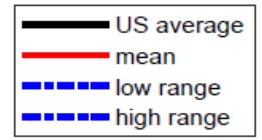




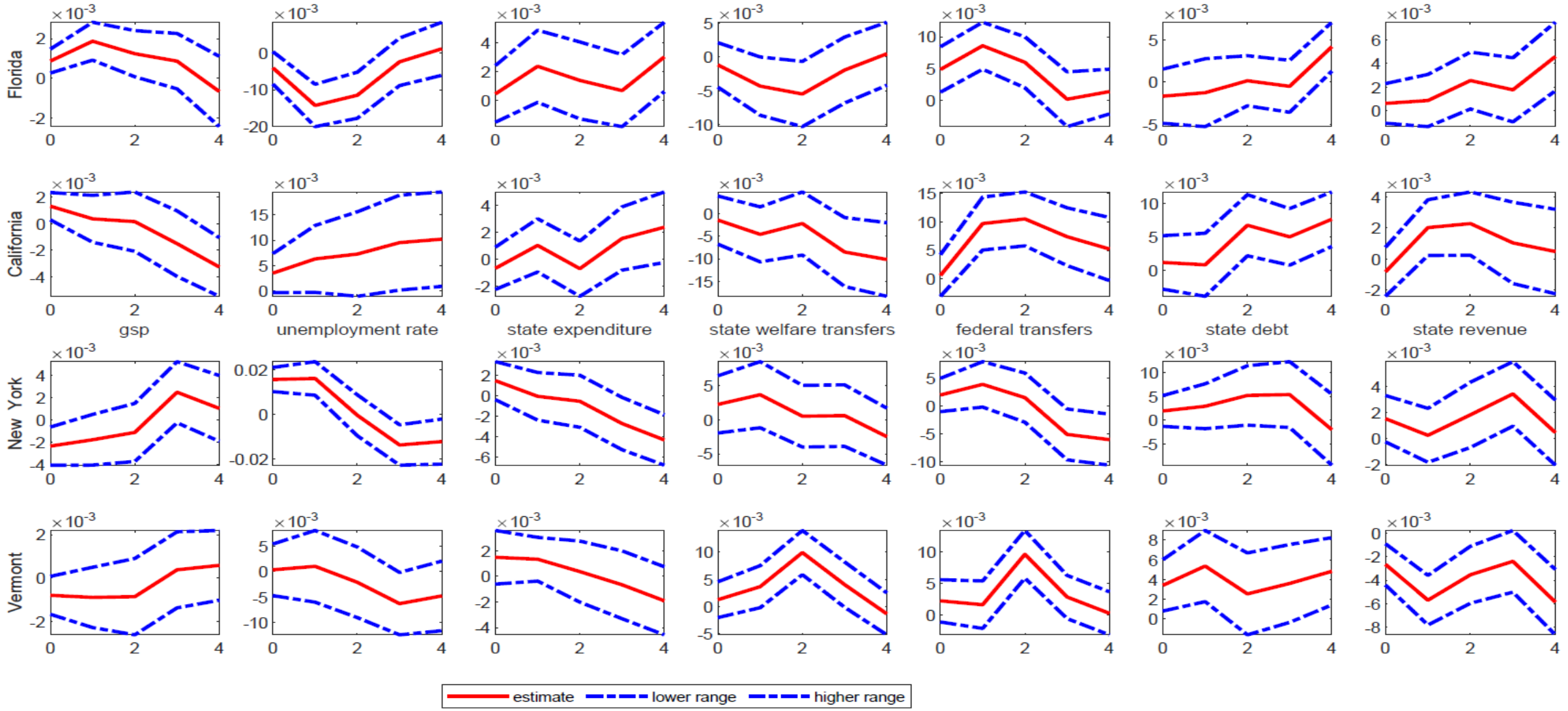








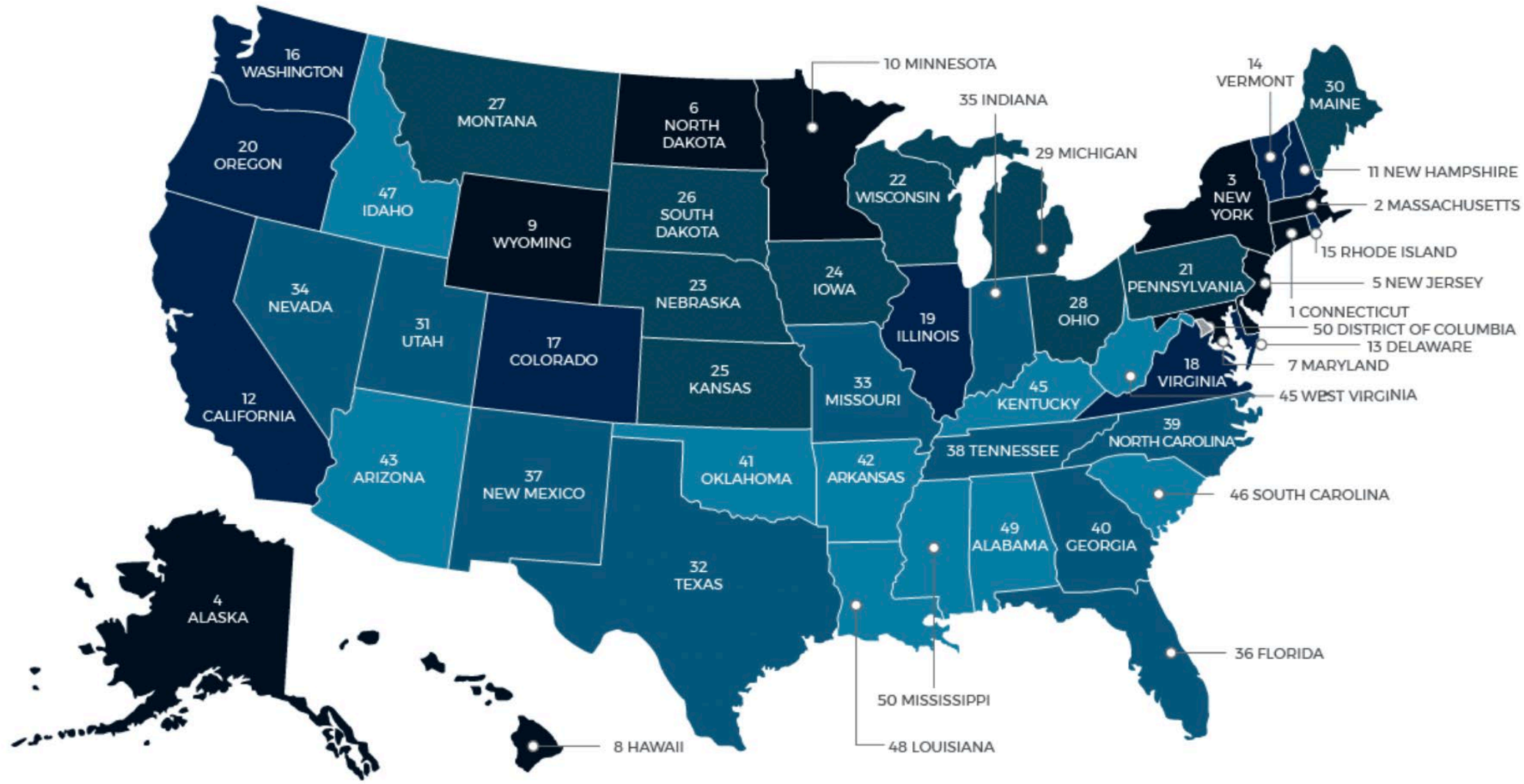
Zooming in on selected states



Still lots of state heterogeneity. Why?

- Income: rich vs. poor.
- Fiscal framework: tight vs. loose budget restrictions.
- Rainy days funds (RDFs) provision: yes vs. no.

How Rich is Each State?



Low per capita personal income

High per capita personal income

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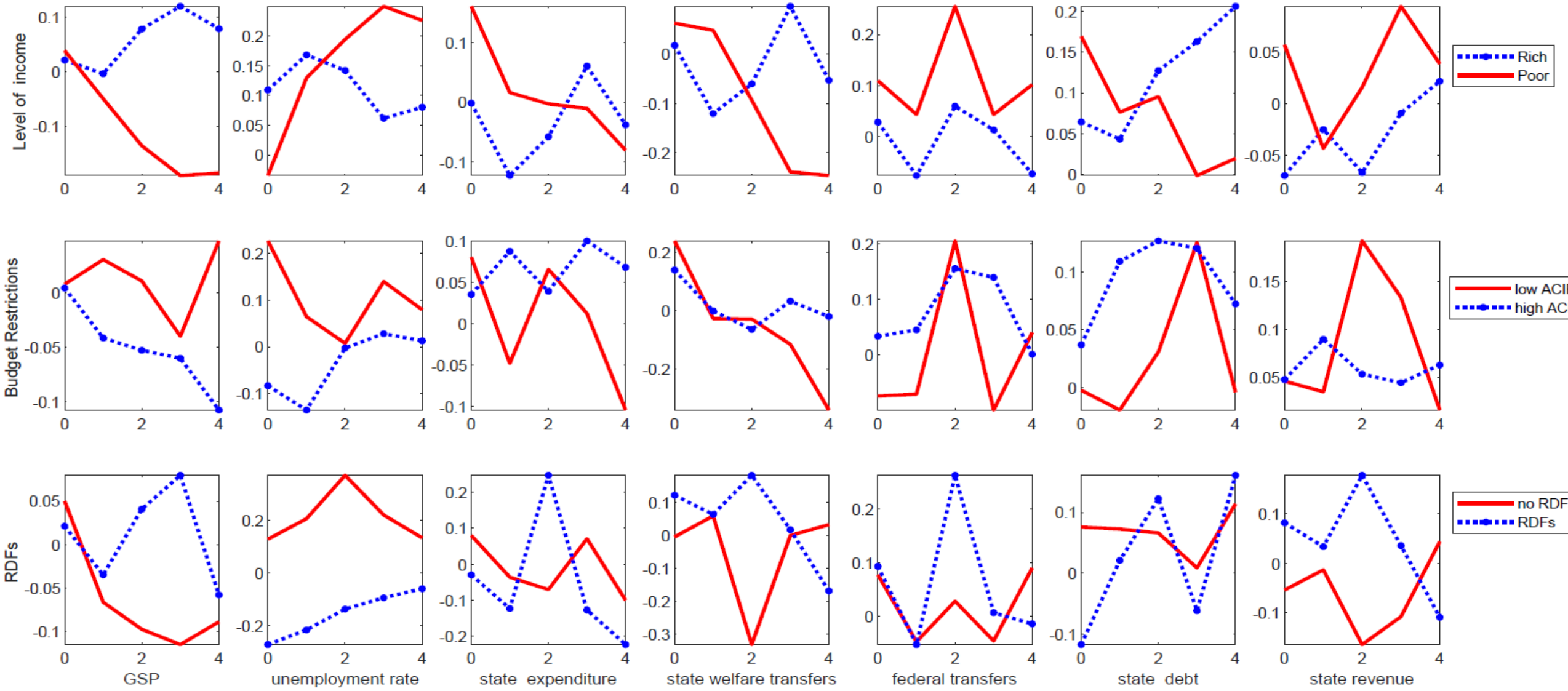
Table 2: ACIR score and RDFs

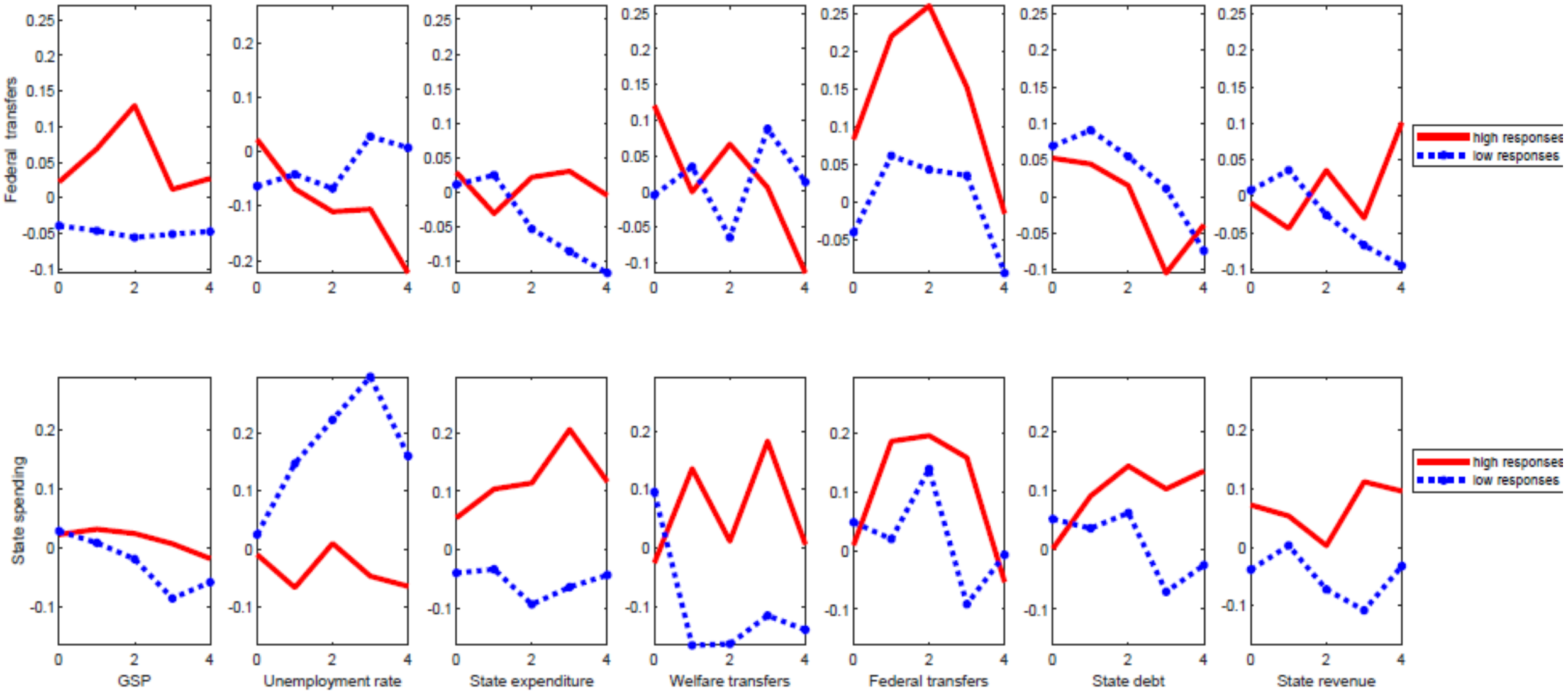
State	ACIR	RDFs	Adoption year	State	ACIR	RDFs	Adoption year
Alabama	10	0		Montana	10	0	
Alaska	NA	1	1986	Nebraska	10	1	1983
Arizona	10	1	1990	Nevada	4	1	1994
Arkansas	9	0		New Hampshire	2	1	1987
California	6	1	1985	New Jersey	10	1	1990
Colorado	10	0		New Mexico	10	1	1976
Connecticut	5	1	1979	New York	3	1	1945
Delaware	10	1	1977	North Carolina	10	1	1991
Florida	10	1	1959	North Dakota	8	1	1987
Georgia	10	1	1976	Ohio	10	1	1981
Hawaii	NA	1	2000	Oklahoma	10	1	1985
Idaho	10	1	1984	Oregon	8	0	
Illinois	4	1	2000	Pennsylvania	6	1	1985
Indiana	10	1	1982	Rhode Island	10	1	1985
Iowa	10	1	1992	South Carolina	10	1	1978
Kansas	10	1	1993	South Dakota	10	1	1991
Kentucky	10	1	1983	Tennessee	10	1	1972
Louisiana	4	1	1990	Texas	8	1	1987
Maine	9	1	1985	Utah	10	1	1986
Maryland	6	1	1986	Vermont	0	1	1988
Massachusetts	3	1	1986	Virginia	8	1	1992
Michigan	6	1	1977	Washington	8	1	1981
Minnesota	8	1	1981	West Virginia	10	1	1994
Mississippi	9	1	1982	Wisconsin	6	1	1981
Missouri	10	1	1982	Wyoming	8	1	1982

The ACIR index measures the intensity of fiscal restrictions:10 indicates very strict restrictions, 0 very loose restrictions. In the RDFs column, a one indicates that a state has Rainy days funds provision, and a zero that it has none.

Responses to disaster cost shocks: Clustering by state features



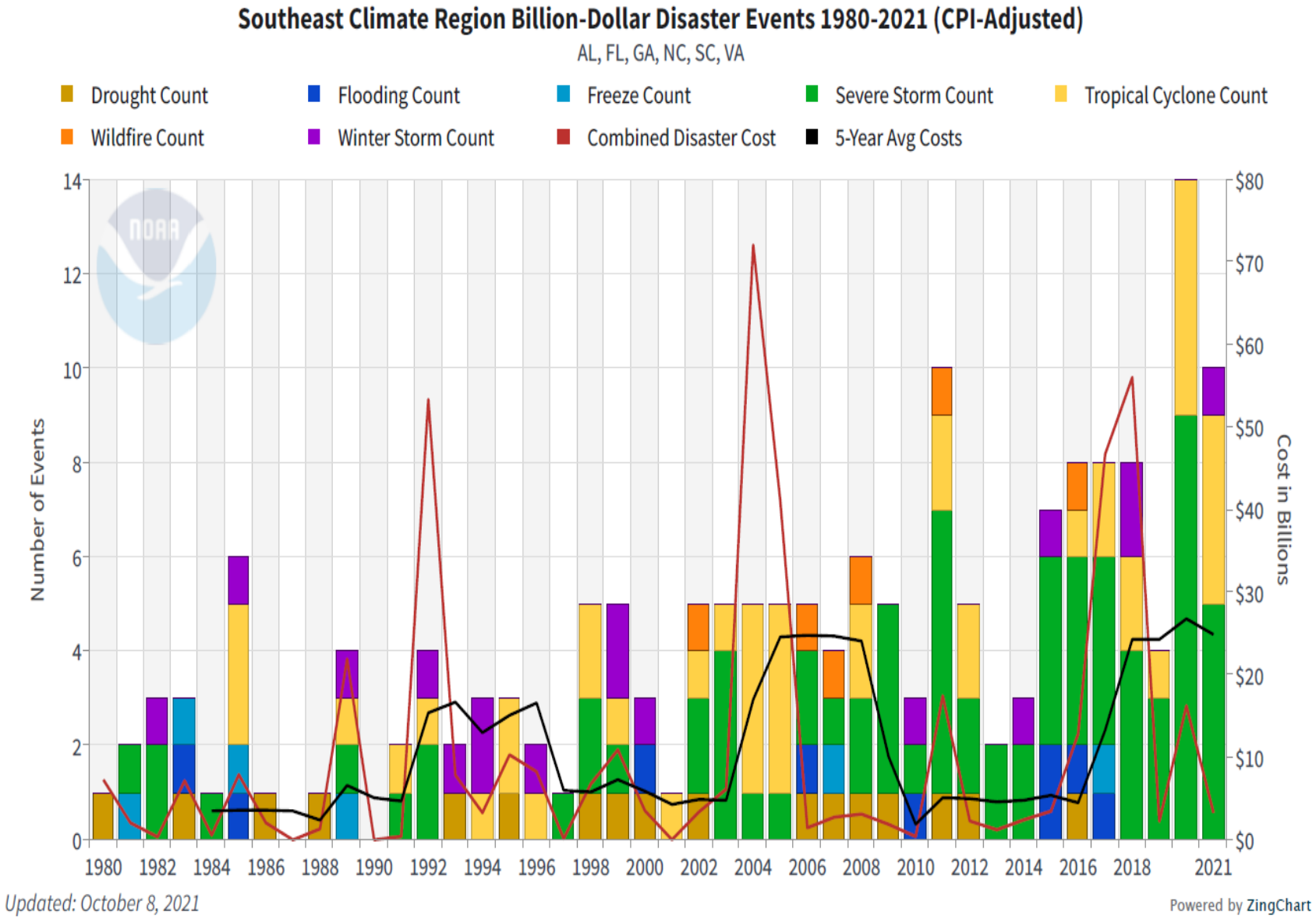
Responses to disaster cost shocks: Clustering by fiscal policy responses



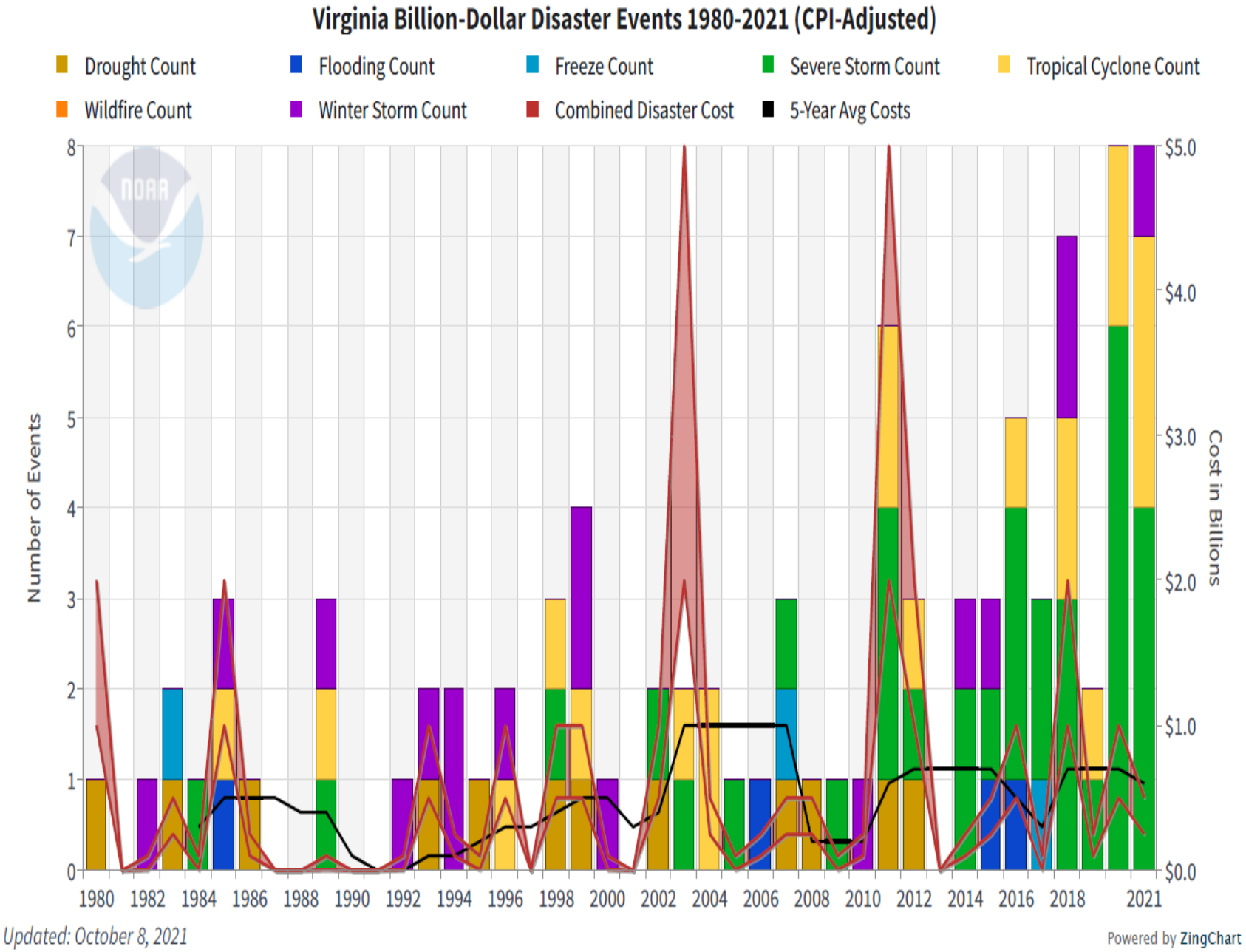
Conclusions

- Disasters generate economic costs.
- Countercyclical fiscal policy can contain the negative real effects of disaster induced shocks.
- States relying more on local resources recover better and experience only moderate and temporary increases in state debt.
- States with strict budgetary requirements and no RDFs have a harder time to recover.
- Inequality: poor states may have harder to escape catastrophic events.

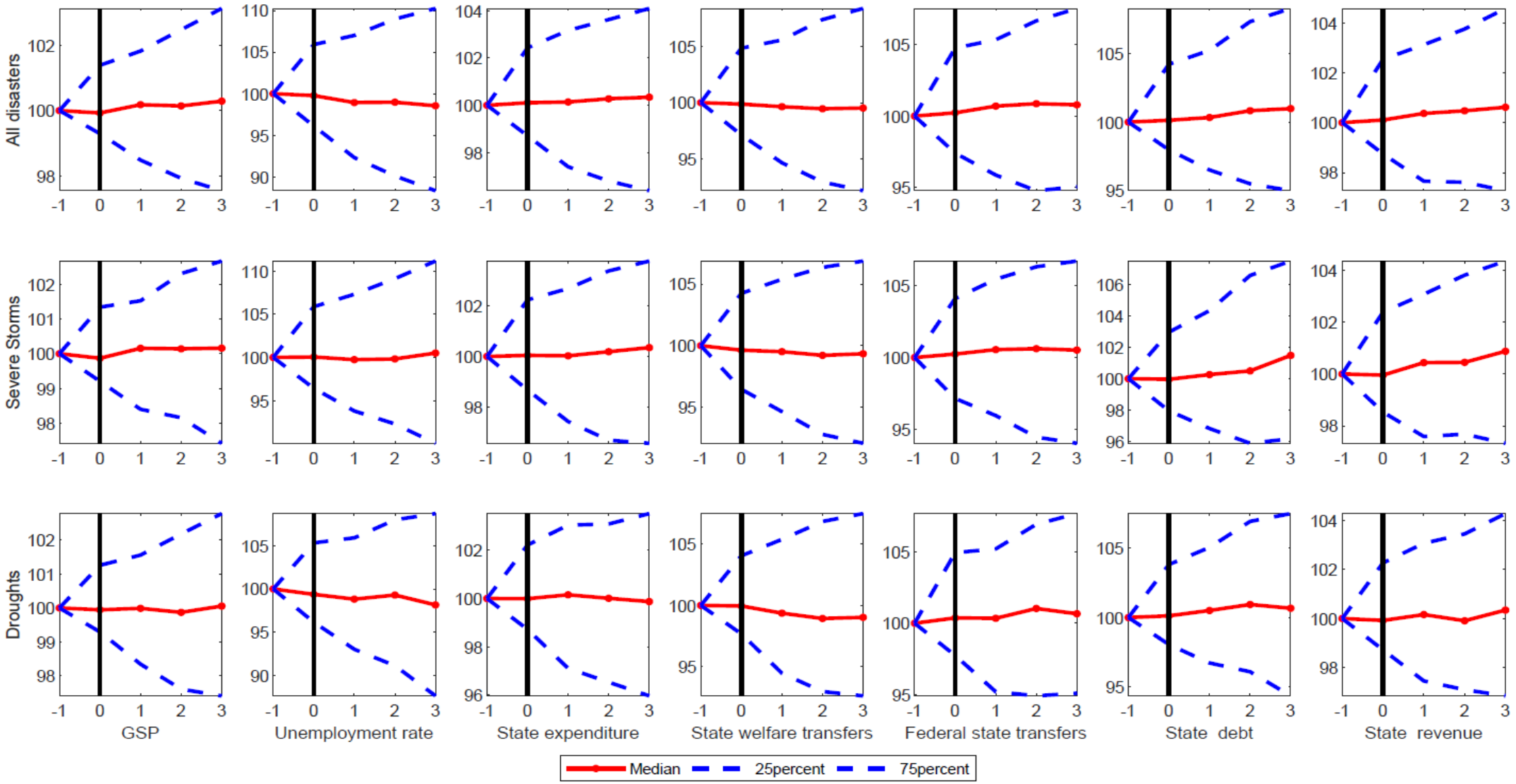
Disasters by area: South-Eastern states



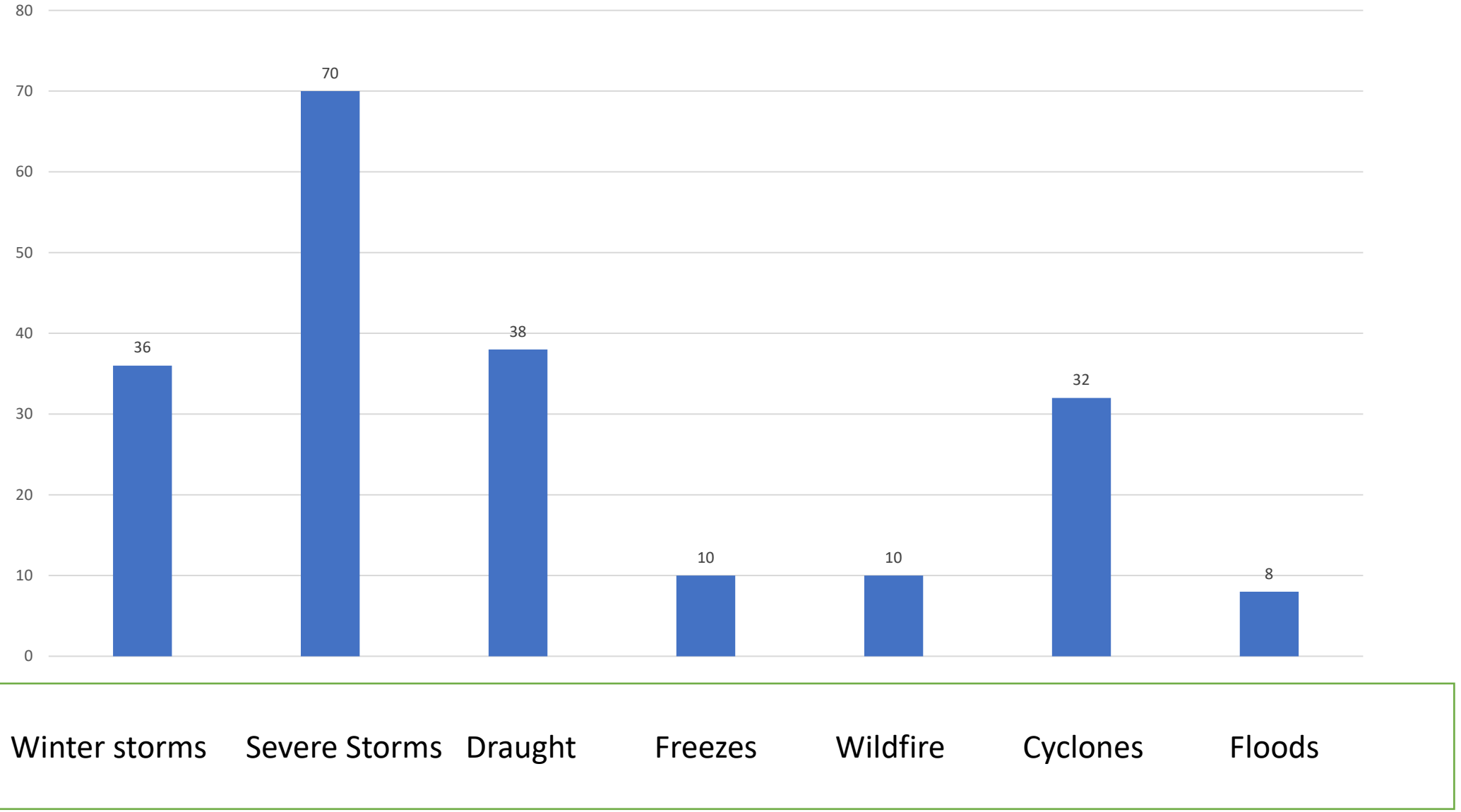
Disasters by state: Virginia



All events and by type II



Number of events in recessionary years



A few facts

- Severe storms and droughts increasing.
- Number of events per year increasing
- Insurance costs increasing.
- The is a regional pattern.
- Special years?

Insurance costs of recessionary events