Political Economy of US States and Rates of Fatal Occupational Injury

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1. Background/Introduction

- "good news" -- US workers experienced a sustained **decline** in the **rate** of fatal occupational injury over the last decades

- "bad news" -- marked **differences** in fatal injury rates and trends still exist **among regions and states**[1-5]

- E,g, average annual rate for all fatal occupational injuries ranged from 1.7 per 100,000 in Connecticut to 24.3 per 100,000 in Alaska

- Rate of decline varied from less than 1% per year in the Northeast to almost 5% per year in the Western states[3,4].

- **causes of geographical diversity** in occupational injury rates are **largely unknown**

- **available work** may reflect: variation in **natural resources**, **topography** and **climate** – one explanation

- consideration of government policy toward economic development and labor, which can influence where **employers locate**, how they **operate**, and the attention they give to worker **safety**[6] - another explanation

- Common factors with **higher rates** (US): that higher rates are concentrated in the **Western and Southern regions**, in **rural** areas, and in **less wealthy** states[7,8].

- Industries/jobs exist in **local context** => **political economic structure** may impact rates
- E.g. variation in the **strength of labor unions**, **state welfare** provisions, and **unemployment** levels influences the **ability of labor** to secure better paying and safer jobs[9].

- Jobs in traditional **manufacturing recede** => declining **unionization rates**, the **contraction of social welfare programs**, and increased capital mobility change the balance of power between capital and labor[12].

- states' capacity to **monitor and regulate health and occupational safety**, depends on their **fiscal health** and their strategies for creating an economic climate conducive to capitalist development and growth[13]

- states' economic characteristics and policies have been neglected as potential determinants of geographic variation in occupational injury rates

- **Goal:** investigate the extent to which the political economy of US states and the relative power of labor predict rates of fatal occupational injury

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2. METHODS

2.1 Injury and Population Data

NTOF: National Traumatic Occupational Fatalities (NTOF) surveillance system

- developed by the National Institute for Occupational Safety and Health (NIOSH) using **death certificates** from the 50 states, New York City and the District of Columbia.

- includes recorded deaths in calendar years 1980-1996 of persons **aged 16 years or older from injuries** (International Classification of Diseases (ICD), 9th Revision, codes E800-E999) that occurred on the job as indicated by the certifier[16].

- Excluded deaths from medical misadventure, non-work related choking on food or other objects, non-occupational poisoning by therapeutic drugs or beverage alcohol and from suicide or with intentionality unknown.

- Eligible deaths were tabulated by calendar year, state and industry, as well as the decedent's sex, age, and race.

- Decedent's **usual industry of employment** was coded by NIOSH to three-digit 1990 US Census codes, which we collapsed into **48 major industrial categories**.

Census (to get the denominator for the injury rate):

- For each category defined by the preceding variables, we **estimated the size** of the workforce at risk from the Census of Population

- Estimates for **1995** were derived via **linear extrapolation** from the censuses of 1980 and 1990

Notes:

- Merging the death data with the workforce estimates required exclusion of observations with invalid or missing data.

- New York City and Washington, DC, reporting units were also excluded b/c state policies were the subject of inquiry

- Sources of data for state political economy variables discussed with the variables

2.2 Measures of State Political Economy

Organizational Capacity of Labor

Represented in the analysis by four variables:
- **union density** (proportion non-agricultural workforce in labor unions)
- **rate of labor grievances** per 1,000 union employees;
- **presence of right-to-work laws**
- **unemployed** (% civilian labor force).

- **Prediction:** states where the capacity of labor is stronger (higher union density), the rate of fatal occupational injury will be lower.

- **Prediction**: states with greater labor market deregulation (e.g., so called "right-to-work laws," which limit labor's ability to organize) should experience higher incidence of fatal injury due to the reduction in the relative power of labor.

- **Prediction**: relative power of labor is also diminished during periods of high unemployment since spells of economic hardship may lead workers into dangerous work and because unemployment provides a reserve pool of labor that can be used to break strikes.

Fiscal Capacity of States

- **outstanding state debt per capita**

Prediction: high state debt may be associated with higher risk of occupational fatality

- Higher state debt may lead to a **decrease** in states' **capacity** to effectively monitor and **regulate** occupational health and safety regulations

- counter argument: state debt may result from investment in public infrastructure or social services that reduce the risk of injury or increase the bargaining power of labor.

Social Wage Policies

- **Aid to Families with Dependent Children (AFDC)**- average monthly payment for those receiving payments

- **Prediction**: higher social insurance payments may lead to lower levels of injury

Table A1: State Political Variables, data sources and summary statistics. The column headed "Worst" 20th percentile if the level of the variable necessary to be coded as "exposed" to the factor, where exposure is defined by the hypothesized direction of the effect on the occupational fatality rate (e.g., higher unemployment was hypothesized to increase the rate of injury, relative to lower unemployment).

Variable	Source	1980		1995	
		Median*	"Worst" 20%-tile	Median	"Worst" 20%-tile
State debt / capita	SLGF[1]	$309	$720	$1,274	$2,539
Unfair labor practices grievances / 1000 union workers	NLRB[2]	1.64	2.17	1.49	2.17
Unemployment rate	BLS[3]	6.7%	8.0%	6.2%	7.5%
Average monthly AFDC payment	SA[4]	$250	$174	$324	$235
Union membership rate	SA	21.9%	15.5%	15.9%	10.5%

[1]SLGF: State and Local Government Finances of the Census of Governments (various years)
[2]NLRB: Annual Report of the National Labor Relations Board (various years)
[3]BLS: Bureau of Labor Statistics (various years)
[4]SA: Statistical Abstract of the United States (various years)

2.3 Data Analysis

- Descriptive analyses of the economic predictors among variables and across states

- Analyses to assess relationships between rates of fatal occupational injury and state political economy variables (also controlling for other characteristics).

- Cross-sectional analyses were conducted separately for the years 1980 and 1995 using log-linear Poisson regression models[20] of the basic form:

$$\log(Y_i) = \alpha + \beta X_i + \log(T_i).$$

where (for a given year)

Y_i =number of deaths in state i,

$\mathbf{X}_i$ = vector containing the political economy variables for that state;

β = vector of coefficients describing the relationship of predictors to the injury rate

T_i = number of person-years accumulated by the employed population in that state.

Six indicators of political economy entered as a group (don't occur in isolation in states)

Fit additional models that included indicator variables for **industry** category and worker **age**, **sex**, and **race** and estimated **person-time** in strata defined by those factors (account for in the composition of state economies and labor forces)

$$\log(Y_{ijklm}) = \alpha + \beta X_i + \gamma C_{jklm} + \log(T_{ijklm})$$

where

Y_{ijklm} = number of deaths in state i, industry j, age k, sex l and race m

T_{ijklm} = number of person years accumulated in this state-industry-age-sex-race combination

γ = vector of coefficients associated with the industry, age, sex and race variables that are coded and collected in the vector C_{jklm}.

[PROC GENMOD in SAS 9.1 for Windows (SAS Institute, Cary, NC, USA).]

Final model: predict the injury rate in 1995 using variables observed in 1980

- used the state political economy variables from 1980 as well as the given state's injury rate in 1980.

- identical to the previous one except that the vector $\mathbf{X}_i$ contained political economy variables for 1980 and an additional variable representing the total occupational fatality rate for the given state in that year

- quantitative political economy variables were dichotomized to provide a common scale for the regression coefficients and to reduce collinearity (10 states with policies hypothesized to be least favorable to labor – "lowest" 20%)

- e^β from the preceding models provide an estimate of the increase in the rate of fatal occupational injury among the 10 least favorable states

3. RESULTS

- Dichotomized political economy variables for each state in 1980 and 1995 are shown in Tables 1 and 2

- Observation: injury rates have declined from 1980 to 1995

- Observation: both regions and states within regions are heterogeneous with respect to injury rates.

- Central and Southern regions have the highest rates of injury, while the Northeast has the lowest.

- E.g., Regional Variability West: injury rate for Alaska was 11.7 per 100,000 in 1980 (14.0 in 1995), while Arizona's rate was 5.7 per 100,000 in 1980 (2.7 in 1995).

- South: [tends to have] highest concentration of socio-economic variables hypothesized to be associated with higher injury rates, while the Northeast has the lowest

- Right-to-work laws exist in all Southern states except Kentucky, but are not found in Northeast or Midwest states except Iowa, suggesting distinct political-economic regions

Table 1: State-specific characteristics in 1980. Shading indicates states in the lowest 20% for the characteristic. The presence of a right-to-work law is denoted with 'y' and its absence is denoted with 'n.' State- and region-specific rates of fatal occupational injury per 100,000 worker-years adjusted for age race and sex are also provided.

	1980	High state debt	Low union density	Low Labor grievace rate	Low social wage	High unem-ployment	Right to Work Law	State Rate	Regional Rate
South	Alabama	.	.	.	▨	▨	Y	8.36	
	Arkansas	.	.	.	▨	.	Y	8.07	
	Florida	.	▨	.	.	.	Y	7.42	
	Georgia	.	▨	.	▨	.	Y	10.00	
	Kentucky	.	.	.	.	▨	N	9.96	8.14
	Louisiana	.	.	.	▨	.	Y	8.84	
	Mississippi	.	.	.	▨	.	Y	12.98	
	North Carolina	.	▨	.	▨	.	Y	7.01	
	South Carolina	.	▨	.	▨	.	Y	6.22	
	Tennessee	.	.	.	▨	.	Y	6.09	
	Virginia	.	▨	.	.	.	Y	7.98	
Northeast	Connecticut	▨	.	.	.	.	N	1.01	
	Delaware	▨	.	.	.	.	N	3.73	
	Maine	.	.	.	.	.	N	7.04	
	Maryland	▨	.	.	.	.	N	3.39	
	Massachusetts	▨	.	.	.	.	N	1.83	
	New Hampshire	.	.	.	.	.	N	3.45	2.80
	New Jersey	.	.	.	.	.	N	1.24	
	New York	▨	.	.	.	.	N	1.67	
	Pennsylvania	.	.	.	.	.	N	5.78	
	Rhode Island	.	.	.	.	.	N	3.00	
	Vermont	▨	.	.	.	.	N	4.01	
Midwest	Illinois	.	.	▨	.	▨	N	5.39	5.34
	Indiana	.	.	▨	.	▨	N	5.65	
	Iowa	.	.	.	.	.	Y	8.22	

Region	State						Y/N	Value	Region Avg
	Michigan	.	.	.	.	▬	N	4.11	
	Minnesota	.	.	.	.	.	N	4.67	
	Missouri	.	.	▬	.	.	N	4.85	
	Ohio	.	.	.	.	▬	N	4.62	
	West Virginia	▬	.	.	.	▬	N	10.43	
	Wisconsin	.	.	.	.	.	N	6.29	
Central	Colorado	.	.	▬	.	.	N	7.40	
	Idaho	.	.	.	.	.	N	14.56	
	Kansas	.	▬	.	.	.	Y	7.97	
	Montana	.	.	.	.	.	N	11.97	
	Nebraska	.	.	.	.	.	Y	10.28	
	New Mexico	.	.	.	.	.	N	8.00	10.45
	North Dakota	.	.	.	.	.	Y	9.90	
	Oklahoma	.	▬	.	.	.	N	6.68	
	South Dakota	.	▬	.	.	.	Y	11.62	
	Texas	.	▬	.	▬	.	Y	11.04	
	Wyoming	.	.	.	.	.	Y	19.29	
West	Alaska	.	.	.	.	▬	N	11.74	
	Arizona	.	.	▬	▬	.	Y	5.72	
	California	.	.	.	.	.	N	6.68	
	Hawaii	▬	.	.	.	.	N	5.90	
	Nevada	.	▬	▬	.	.	Y	11.80	7.1
	Oregon	▬	.	.	.	▬	N	8.33	
	Utah	.	.	.	.	.	Y	8.64	
	Washington	.	.	.	.	.	N	7.75	

Somewhat different geographic patterns emerged from analyses of data for 1995.

- State rates adjusted for workforce composition lowest in the Northeast and northern Central states and higher across the southern section of the country (Table 2)

- Adjustment for industry improved the fit of the model and resulted in geographic patterns broadly similar to those observed in 1980, with lower rates clustered in the Northeast, upper Midwest and West, and higher rates in the Central states (Figure 1b)

Table 2: Descriptive data for state-specific characteristics in 1995. Shading indicates states in the lowest 20% for the characteristic. The presence of a right-to-work law is denoted with 'y' and its absence is denoted with 'n.' State- and region-specific rates of fatal occupational injury per 100,000 worker-years adjusted for age race and sex are also provided.

	1995	High state debt	Low union density	Low Labor grievace rate	Low social wage	High unem-ployment	Right to Work Law	State Rate	Regional Rates
South	Alabama	.	.	.	▓	▓	Y	5.40	
	Arkansas	.	▓	.	▓	.	Y	6.15	
	Florida	.	.	.	.	.	Y	4.67	
	Georgia	.	▓	.	.	.	Y	5.61	
	Kentucky	.	.	▓	▓	.	N	6.36	
	Louisiana	.	▓	▓	▓	.	Y	7.37	4.91
	Mississippi	.	▓	▓	▓	.	Y	8.74	
	North Carolina	.	▓	.	▓	.	Y	4.08	
	South Carolina	.	▓	.	▓	▓	Y	4.70	
	Tennessee	.	.	.	▓	.	Y	4.07	
	Virginia	.	▓	.	.	.	Y	2.53	
Northeast	Connecticut	▓	.	.	.	.	N	1.19	
	Delaware	▓	.	.	.	.	N	2.06	
	Maine	.	.	.	.	▓	N	1.06	
	Maryland	.	.	.	.	.	N	1.98	
	Massachusetts	▓	.	.	.	.	N	1.50	2.11
	New Hampshire	▓	.	.	.	.	N	0.76	
	New Jersey	▓	.	.	.	▓	N	1.97	
	New York	▓	.	.	.	▓	N	2.16	
	Pennsylvania	.	.	.	.	.	N	3.06	
	Rhode Island	▓	.	.	.	▓	N	1.85	
	Vermont	.	.	▓	.	.	N	3.41	
dw	Illinois	.	.	.	.	.	N	3.23	3.15
	Indiana	.	.	.	▓	.	N	3.64	

Region	State							Y/N	Value	Region Avg
	Iowa	.	.	.	.	.		Y	3.62	
	Michigan	.	.	.	.	.		N	2.62	
	Minnesota	.	.	.	.	.		N	2.82	
	Missouri	.	.		.	.		N	4.05	
	Ohio	.	.	.	.	.		N	2.15	
	West Virginia	.	.		.			N	7.67	
	Wisconsin	.	.	.	.	.		N	3.36	
Central	Colorado	.	.		.	.		Y	4.74	
	Idaho	.	.	.	.	.		Y	8.92	
	Kansas	.	.	.	.	.		Y	4.51	
	Montana	.	.	.	.	.		N	4.22	
	Nebraska	.	.	.	.	.		Y	4.81	4.97
	New Mexico	.	.	.	.			N	6.13	
	North Dakota	.	.	.	.	.		Y	5.37	
	Oklahoma	.	.	.	.	.		N	5.65	
	South Dakota		.	.	.	.		Y	7.09	
	Texas	.		.		.		Y	4.47	
	Wyoming	.	.	.	.	.		Y	9.22	
West	Alaska		.	.	.			N	14.00	
	Arizona	.	.	.	.	.		Y	2.65	
	California	.	.	.	.			N	3.20	
	Hawaii	.	.	.	.	.		N	1.85	3.42
	Nevada	.	.		.	.		Y	6.04	
	Oregon	.	.	.	.	.		N	3.55	
	Utah	.	.	.	.	.		Y	4.17	
	Washington	.	.	.	.			N	3.38	

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Geographic distribution of state occupational fatality rates

* not changed markedly by adjustment for political economy: in both 1980 and 1995, lower rates of fatal injury remained concentrated in the Northeast, Midwest and West, while higher rates prevailed in the South and Central areas

Figure Captions

Figure 1. Maps showing fatal occupational injury rates per 100,000 workers by state, modeled using Poisson regression (note the category shading corresponding to injury rate categories differs among the four maps).

1a (upper left). 1980 rates adjusted for industry and worker age, sex, and race.

1b (upper right). 1995 rates adjusted for industry and worker age, sex, and race.

1c (lower left). 1980 rates adjusted for six political economy indicators; industry; and worker age, sex, and race.

1d (lower right). 1995 rates adjusted for six political economy indicators; industry; and worker age.

… Gradient of "heat" … [Blue (low rate) -> Red (high rate)]

Rate per 100,000
Workers

4.5 - 5.7
5.7 - 6.4
6.4 - 6.9
7.0 - 8.0
8.0 - 12.1

Rate per 100,000
Workers

2.8 - 3.3
3.3 - 3.6
3.6 - 3.8
3.9 - 4.2
4.3 - 5.7

Rate per 100,000
Workers

2.4 - 4.6
4.6 - 5.9
5.9 - 7.7
7.8 - 8.7
8.9 - 12.9

Rate per 100,000
Workers

1.7 - 2.8
2.9 - 3.6
3.7 - 4.2
4.2 - 5.0
5.4 - 8.1
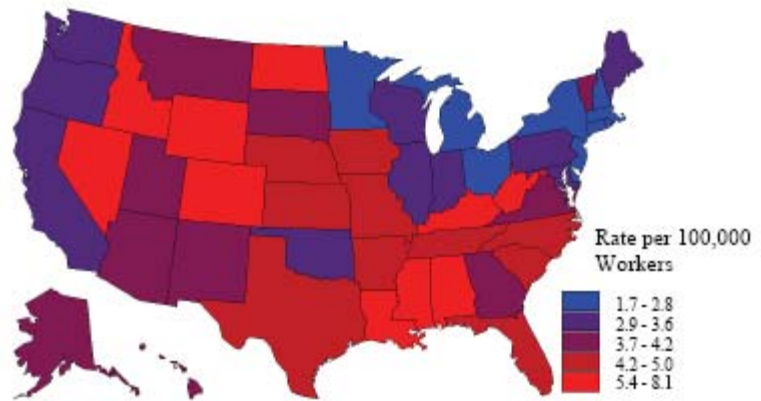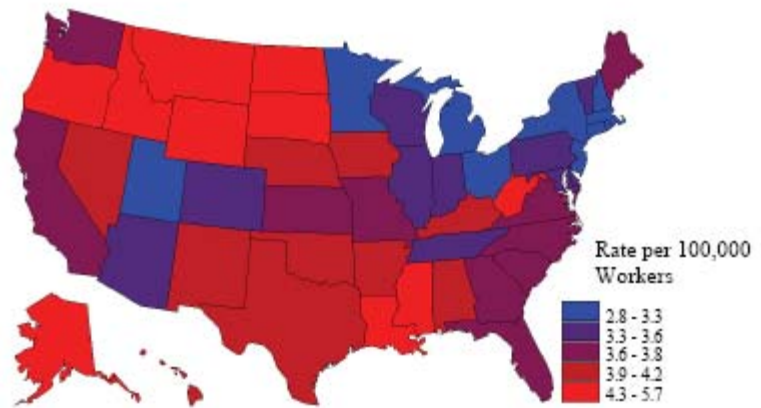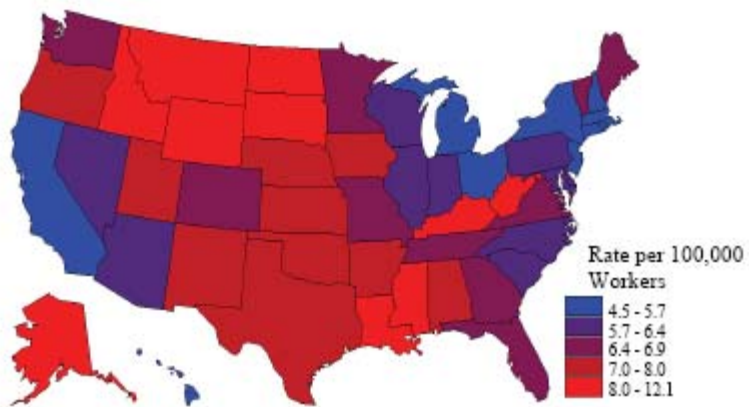
Impact of state political economy variables on occupational fatal injury rates
(adjusting for workforce demographics and industry)

- effects of most 1980 indicators of state political economy were consistent with the direction hypothesized

- higher fatal injury rates were associated with low union density, low labor grievance rates, low social wages, high unemployment and right-to-work laws (Table 3).

Table 3. Relationship of state political economy indicators in 1980 and 1995 and the rate of fatal occupational injury in the same years, adjusted for industry and worker age, sex, and race.

	1980			1995[b]		
	RR	95% CI		RR	95% CI	
High state debt	0.57	0.52	0.63	0.72	0.65	0.80
Low union density	1.16	1.08	1.25	0.93	0.84	1.02
Low labor grievance rate	1.09	0.97	1.17	0.69	0.58	0.75
Low social wage	1.09	1.00	1.18	1.12	1.04	1.22
High unemployment	1.12	1.05	1.20	1.10	1.02	1.18
Right-to-work law	1.20	1.10	1.32	1.36	1.25	1.48

[a]RR, rate ratio; CI, confidence interval
[b]Omits deaths in Oklahoma County, Oklahoma, on the date of federal building bombing.

Observations:

- 1980 Analyses: magnitude of these associations was modest, however, with rate ratios (RRs) ranging from 1.09 to 1.20; 95% confidence intervals (95% CIs) excluded 1.0 for all but labor grievance rates and social wages.

- High state debt was associated with lower fatal injury rates (RR 0.57, 95% CI 0.52-0.63).

- 1995 Analyses: yielded RRs in the hypothesized direction for low social wages, high unemployment and right-to-work laws all with 95% CIs that excluded 1.0 (Table 3)

- RRs for high state debt, low union density and low grievance rates were in the opposite direction, although the 95% CI for union density included unity
  .

Analysis using data from 1980 to predict injury rates in 1995

- States with higher rates of injury in 1980 were predicted to have relatively higher injury rates in 1995 (RR 2.26, 95% CI 1.99-2.57) (see Table 4)

- Rate ratios for state political-economic characteristics were smaller in magnitude, but states with low union density, low labor grievance rates, and high unemployment in 1980 also tended to have higher rates in 1995

- States with high levels of debt in 1980 tended to have reduced rates in 1995

- Neither the presence of right-to-work laws or low social wages in 1980 was associated with increased injury rates in 1995

Table 4: Prediction of state-specific fatal occupational injury rates in 1995 from state-specific injury rates and socioeconomic characteristics measured in 1980. All variables shown were included in the model with simultaneous adjustment for industry and worker age, sex and race.

Predictor in 1980	RR[a]	95% CI[a]	
Fatal injury rate	2.26[b]	1.99	2.57
High state debt	0.90	0.82	0.99
Low union density	1.09	0.99	1.20
Low labor grievance rate	1.19	1.10	1.29
Low social wage	1.03	0.94	1.14
High unemployment	1.08	0.99	1.17
Right-to-work law	0.91	0.81	1.02

[a]RR, rate ratio; CI, confidence interval.
[b]We define this relative rate as the relative increase in the 1995 occupational fatality rate per absolute increase in the state specific 1980 fatality rate of 1 per 100,000.

4. DISCUSSION

Our analysis of fatal occupational injury data for the United States in the 1980s & 1990s

- showed that **political-economic characteristics** of states, including government debt, union density, labor grievance rates, social welfare payments, unemployment, and right-to-work laws, were **significant predictors of fatal occupational injury rates**.

- Factors explain additional variation in states' fatal injury rates after accounting for industry and workforce composition

- States whose political-economic climates favored industry over labor tended to have higher rates of fatal occupational injury, particularly at the beginning of the study period.

- **high state debt** was associated with **lower fatal injury rates** (result of investments that increase safety? indicative of local economic downturns leading to reduced levels of business activity and consequently to lower injury rates?)

- The relationships of some political economy indicators with injury rates were inconsistent in different types of analyses

- comparison of the findings suggests that the characteristics associated with high injury rates in the same year may not be the same ones that predict high rates in later years (that subsequent effects are more evident on a shorter **time scale** than the 15-year window we used here?)

- Empirical research investigating the impacts of local social and economic conditions on occupational injury rates is rare.

* **High unemployment** coincided with **increasing occupational injury rates** in manufacturing industries in the United States (1948-85) - possible effect might be due to labor's decreased bargaining power in times of high unemployment[21].

* **Number of ILO health and safety** conventions ratified, length of ILO membership, and per capita income were associated with **reduced fatal injury rates** at the national level[22].

* Rate of **injury** in Austria **declined** as **gross domestic product** increased over the 50-year period (1955 to 2004) - authors concluded that economic development leads to improvements in occupational safety[23]

* Impact of public policy on occupational injury rates in US has been directed toward policies that attempt to create **incentives** for employers to improve safety through **regulation and enforcement** or by **adjusting insurance costs**.

* While there is evidence that such policies may influence occupational injury rates, the impact of firm-level effects of **citations & penalties** are supported most strongly[24-25].

*   Little direct evidence concerning the effect of state occupational safety policies on long-term trends or geographic variation in occupational injury rates.

*   About 1/3 of the states established occupational safety and health regulatory agencies during the period of this study, remainder continued under federal oversight[27].

*   State programs are required only to be "as effective as" those of the federal Occupational Safety and Health Administration, however, so there is no prior reason to expect workplaces would be notably safer in states that operate regulatory agencies.

Data Limitations

* We characterized the relationship of fatal occupational injury rates to state political economy using national data with sufficient detail to account for industry and the sex, age and race composition of the working population

* analysis confined to the years 1980 and 1995 when injury and political economy data were available, so the findings necessarily reflect conditions during those years .

* NTOF system was the only comprehensive national surveillance system for fatal occupational injuries before 1992 (now BLS/CFOI available) – similar epi patterns[28]

* Estimate of the working population in 1995 obtained by extrapolating from censuses in 1980 and 1990 - shown previously that the approach we used to estimate populations in non-census years produces negligible bias in most situations[29,30]

* Political economy indicators we used have other limitations.
  Unemployment statistics do not measure **underemployment** and other labor market conditions (for example, informal employment) that may weaken the bargaining position of labor.

  AFDC was a family-based benefit that was **only available to workers living with their children**, so state-to-state variation in the proportion of childless workers could lead to misclassification.

Measures of the fiscal capacity of states may not accurately gauge the regulatory environment of occupational safety and health.

Our measure of state debt does not take into account the **sources of debt** (infrastructure versus social welfare programs) that may influence state capacity.

Conclusion

* Observed regional clustering of state political economies—with the South and Northeast emerging as distinct end members—and suggest that higher rates of fatal occupational injury are associated with a state policy climate favoring business over labor.

* Further research is needed to explore other effects of public policy on occupational health and safety and to more deeply examine the effects of specific measures.

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