California Center for Population Research
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Behavioral Response to China's 2002-2003 SARS Epidemic

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China's SARS Epidemic of 2002-2003

- SARS = "Severe Acute Respiratory Syndrome"
- Began late autumn, 2002
- Spread from south China to Hong Kong, Southeast Asia, Beijing, elsewhere

SARS epidemic notable for:

1. Deadliness
2. Small number of cases (8,083 including Hong Kong and Macao)
3. Ease with which virus spreads
4. Apparently pronounced impact on local economies and everyday lives

Claimed impact of epidemic:

- Migration from rural to urban areas temporarily halted
- Migrants went home from urban areas to rural places of origin
- Economic activity declined precipitously

What *really* happened?

- Chinese gov't appears not to have published own studies
- World Tourism and Travel Council has web-published assertions about impact of SARS on China's economy, basis unknown
- Outside of biomedical fields, research on SARS in China has tended to be psychological

- Anecdotally, know gov't created forms for process-generated data at village level
- Don't know whether comparable forms exist for urban areas
- Can't get access to process-generated data
- Solution: Collect own data

Our Study

- With D.J. Treiman, I had completed a pretest for a survey in 2002
- For 2003, planned full-scale pilot study of feasibility of generating true probability sample of the population of China, with emphasis on migrants

- Focus was on areas where migrants were likely to be. Could *we* find them? If so, how?
- China's internal passport (*hukou*) system no longer tightly run
- Planned to concentrate on urban and rural-urban transitional areas
- Carry out local population enumeration and probability list-sampling

- Full-scale pilot was set to be carried out in Spring, 2003.
- As field work began, central gov't announced that SARS epidemic existed, and took steps to contain it. (April 20, 2003—crucial date.) Field work stopped.
- Before epidemic was over, we designed SARS questionnaire module.
- Went back to field in October, 2003.

Questions we address:

1. What steps did people take to avoid infection?
2. Organized social response to epidemic?
3. Employment altered?
4. Travel altered?
5. Individual response contextually driven?
6. Sociodemographic basis to response?

Nature of Survey

- Probability sample of individuals, realized *N* = 1,059.
- By design, sampled in four province-level areas (2 high SARS, 2 low SARS)
- Goal: Incomplete balanced design: High SARS vs. Low SARS province by rural-urban subclassification.
- Each province contributes three cells in one and only one SARS category.

- Questionnaire, manuals, study design, sampling design by UCLA team.

- Field work: Survey team consisted of graduate students and faculty at a Beijing university.

- Field work: Autumn 2003 and Spring 2004.

Table 1. Distribution of Sampled Places

Place Type	High SARS	N	Low SARS	N
Rural				
Bedroom village	Beijing	97	Suzhou	102
In-migrant village	Guangzhou	101	Chengdu	99
Factory dormitory	Guangzhou	101	Chengdu	100
Urban				
Rural-urban trans.	Beijing	102	Suzhou	98
Low SES	Guangzhou	98	Chengdu	97
Medium to High SES	Beijing	6	Suzhou	58

Village-in-city, Guangzhou

High income neighborhood, Beijing

In-migrant village, Chengdu

- Did not achieve balance, due to access problems in high SES neighborhoods.

- Interested in High SARS vs. Low SARS contrast.

- Thus, although not primary interest in SARS analysis, need to control rural-urban subclassification—as well as individual-level characteristics.

Analytic Focus

1. Specific behaviors of individuals during SARS epidemic, including
   — everyday activities
   — work interruptions
   — travel

2. Reports on organizational and aggregate actions or behaviors

Table 2. Selected SARS Individual Behavioral Items

Mnemonic	Definition	Prop. "Yes"
knew	Knew about SARS before April 20, 2003	.69
medical	Took "medical measures" to prevent SARS	.46
hoard	Accumulated food or other goods	.13
avoid	Tried not to shop or go out for entertainment	.62
wash	Washed hands more than before epidemic	.73
gongshou	Used *gongshou* (instead of hand shake)	.09
mask	Wore a mask	.44
fencan	Began to use *fencan* (serving chopsticks)	.05

Table 3. Respondent-Provided Reports of Socially Organized or Aggregate Response to SARS Epidemic

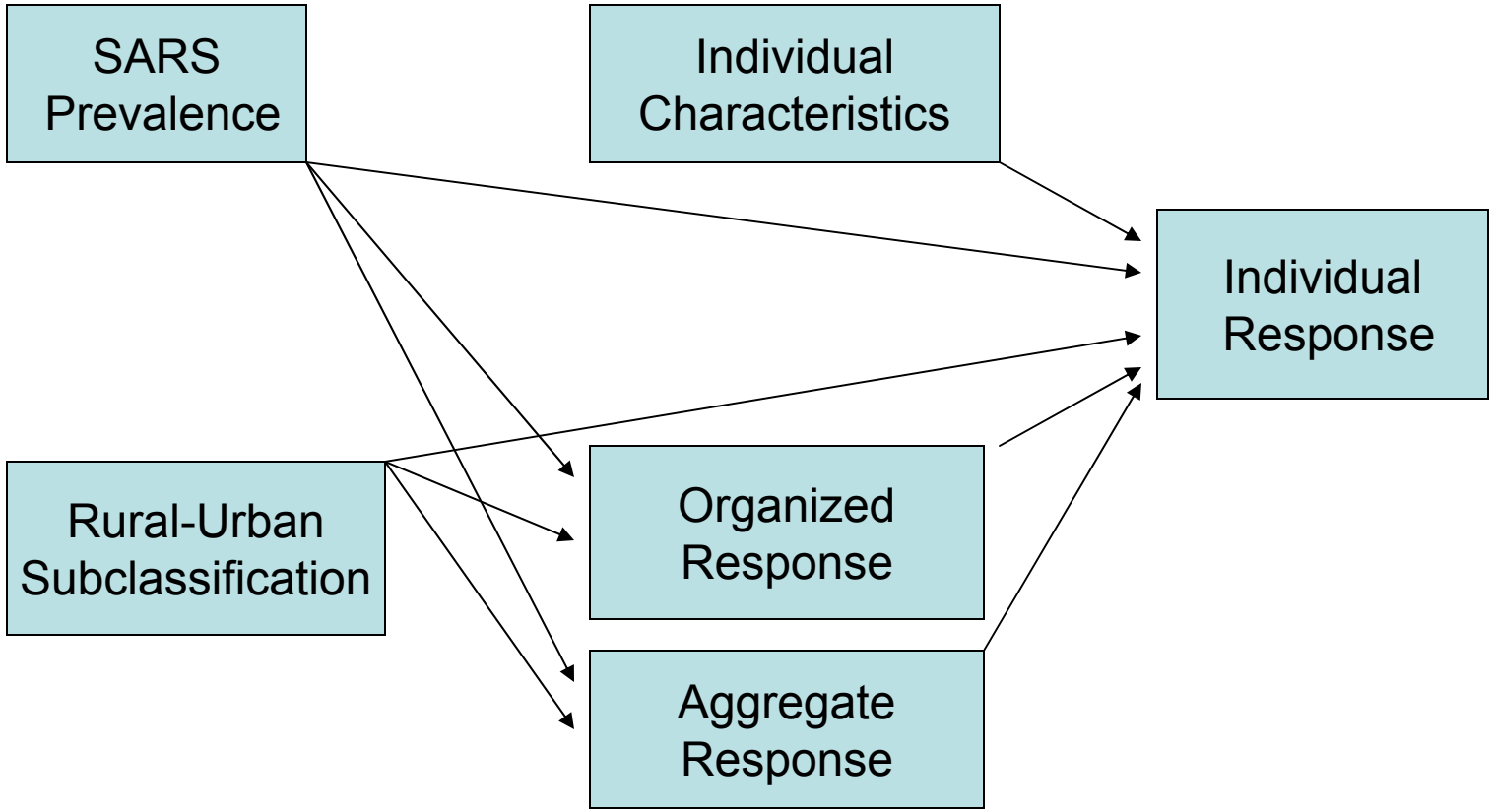
Mnemonic	Definition	Prop. "Yes"
disinfect	Was your place of work or residence disinfected?	.85
restrict	Did your place of work or residence restrict entry and exit?	.63
quarantine	At your place of residence were suspected SARS patients quarantined?	.46
spitting	Did spitting in public decrease around your place of residence?	.67

Sociodemographic Covariates

(all dummies or dummy classifications)

Hukou status	1 = permanent local *hukou;* 0 = other
Education	None or primary; lower middle school; upper middle school; post-upper middle school
Gender	1 = male; 0 = female
Age	20-29; 30-39; 40-49; 50-63
Occupation	Nonmanual; manual; none
Party membership	1 = party member; 0 = other

Modeling SARS Item Responses (Cross-sectional)



Logistic Regression for SARS Items

i = individual
j = SARS item
DSARS = High SARS vs. Low SARS place
x = covariates

$$\eta_{ij} = logit(\Pr Y_{ij} = 1 | DSARS_i, x_i) = \beta_{0j} + \beta_{1j} DSARS_i + \sum_{k=2}^{K} \beta_{kj} x_{ik}$$

Table 4. Associations Between SARS Items and Whether R Lives in High SARS Place (Proportions and Proportionate Differences)

		High SARS vs. Low SARS Contrast	
SARS Item	High SARS Areas: Prop. "Yes"	Uncontrolled	Controlled
knew	.76	.12***	.11***
medical	.52	.12***	.08***
hoard	.18	.09***	.06***
avoid	.70	.16***	.15***
wash	.80	.10***	.06*
gongshou	.09	.04	.02
mask	.55	.22***	.20***
fencan	.07	.03	.01

Table 5. Signs of Statistically Significant *Relationships* for Covariates in Logistic Regressions for Each SARS "Individual" Item

Cov.	knew	med	hoard	avoid	wash	*gongs*	mask	*fencan*
P*hukou*		-			-		-	
Educ	+				+			
Male		-			-	+		
Age			-				-	
Occ								
Pmemb								
disinfect	X	+	+	+	+	+	+	
restrict	X	+					+	+
quarant	X			+	+		+	
spitting	X			+	+		+	

Take-away: Determinants of Responses to Individual SARS Items

1. Epidemiological context matters a lot
2. So does organized social response
3. Perceptions of aggregate behavioral change also appear to affect individual behavior
4. Hand washing—the only genuinely prophylactic behavior—is a function of education in a meaningful way
5. Sociodemographically defined position relatively unimportant determinant of behavior
6. Considerable uniformity of reported individual behavior
7. Considerable uniformity of socially organized response

Work Stoppage & Travel Interruption Setup

- Compare 2003 with 2002
- Treat both problems as counting processes
- Divide each year into periods (WHO travel advisories):
  - 1: Spring Festival to March 31
  - 2: April 1 to April 19
  - 3: April 20 to May 23 (April 20 is significant)
  - 4: May 24 to June 23
  - 5: June 24 to September 30

More on Work Stoppage & Travel Interruption Setup

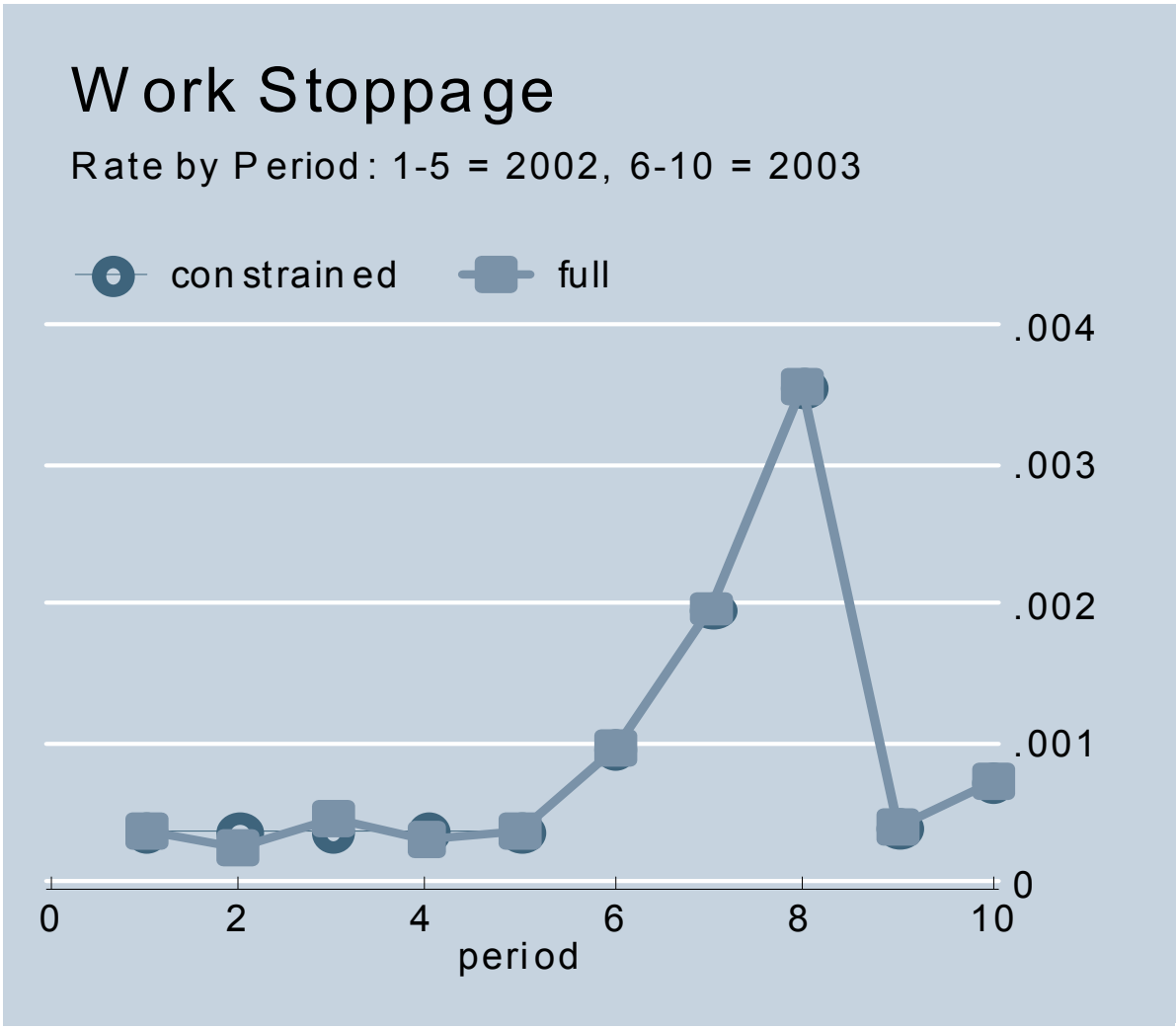
- Count number of events per individual per period
- Turns into 2-level problem
- Adjust for period width
- Fit exponential regression

2-Level (GEE) Poisson Regression for Work Stoppage

$$C_{ij} = \exp\{\ln(E_i) + \beta_0 + \sum_{i=2}^{i=10} \delta_i P_i + \beta_1 DSARS_j + \sum_{k=2}^{K} \beta_k x_{jk}\}$$

(*i* = time period; *j* = individual; *k* = covariate)

Figure 1. Estimated Daily Rate of Per Individual Work Stoppage, from Spring Festival to October, 2002 and 2003



Take-away, Work Stoppage Multivariate Analysis

- *None* of the included controls affect the temporal pattern of work stoppage: individual sociodemographic characteristics; high SARS vs. Low SARS place

- No high SARS vs. Low SARS effect

- But, there is a general epidemiological effect that we have seen in the figure

2-Level (GEE) Negative Binomial Regression of Travel

$$C_{ij} = \exp\{\ln(E_i) + \beta_0 + \sum_{i=2}^{i=10} \delta_i P_i + \beta_1 DSARS_j + \sum_{k=2}^{K} \beta_k x_{jk} + \varepsilon_{ij}\}$$

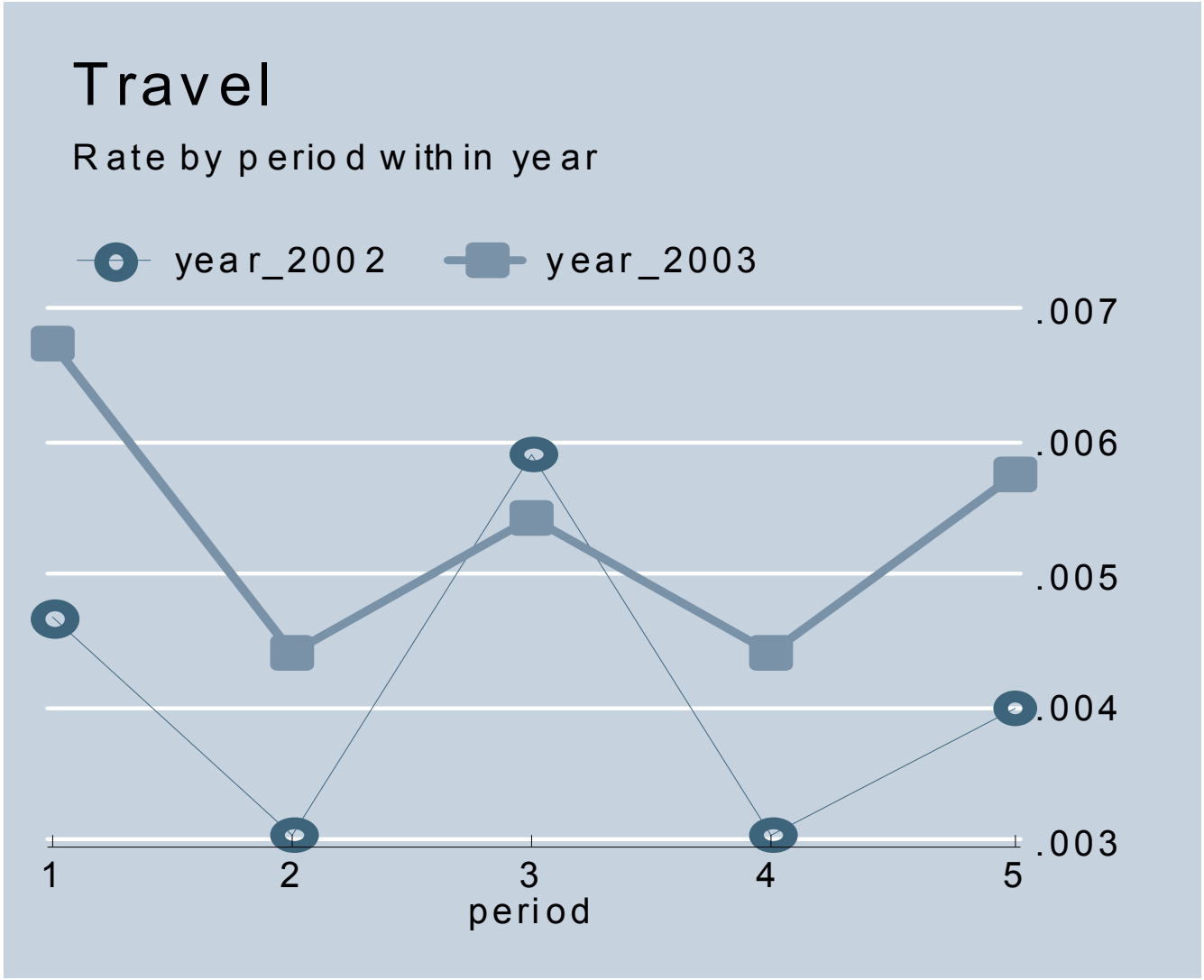
- Expect seasonality in travel rates
- ***All other things equal***, expect higher travel rates in 2003 than in 2002, due to memory decay
- ***Without SARS epidemic***, expect additivity of year and period within year
- We find instead that the data support a constrained interaction between year and period within year

The constraint is to include only a single interaction between year and period within year.

The relevant period is period 3 (April 20 to May 23) in 2003. The constrained interaction can be written as:

$$\gamma Year + \sum_{s=2}^{s=5} \lambda_s T_s + \tau Year \cdot T_3$$

Figure 2. Estimated Daily Rate of Per Individual Travel, From Spring Festival to October, 2002 and 2003



Take-away From Travel Multivariate Analysis

- The travel rates for 2003 are greater than those for 2002, *except* for period 3 in 2003.
- As just seen, there is a clear "epidemiological" effect—the rate of travel declined during the period when efforts to contain SARS were at their peak in 2003.
- The "SARS effect" in the last figure can be explained statistically and *plausibly* by two additional interactions:
  - Permanent *hukou*● Period 3 ● 2003
  - High SARS place ● Period 3 ● 2003

Specifically:

- Travel dropped in high SARS places in period 3 in 2003
- Travel during period 3 of 2003 was lower for those with permanent *hukou.* That is, the difference between migrants and nonmigrants in travel rates increased in period 3 of 2003, with *nonmigrants traveling less* during this period.

These two factors explain travel decline for period 3 in 2003.

Conclusions

- The SARS epidemic
  - Precipitated individual as well as socially organized efforts to self-protect
  - Led to job loss
  - Decreased travel
- Response was
  - Widespread
  - Still, there was epidemiologically structured as well as *independent* socially organized response
  - Not a lot of socioeconomic/sociodemographic differentiation

Final Observation

- This has been an exercise in the identification of contextual effects, although not intentionally so.
- To the extent that contextual effects are present, we were able to identify them because they are exogenous—the result of an epidemiological “shock.”