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January 10, 2013

Public Health Expenditures, Public Health Delivery Systems, and Population Health

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Available at: https://works.bepress.com/glen_mays/68/

Public Health Expenditures, Public Health Delivery Systems, and Population Health

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Acknowledgements

Research support provided by:

- ◆ Robert Wood Johnson Foundation's Changes in Healthcare Financing and Organization (HCFO) Initiative
- ◆ Robert Wood Johnson Foundation's Public Health Practice-Based Research Networks program
- ◆ National Institutes of Health Clinical and Translational Science Award

Preventable disease burden and national health spending

>75% of national health spending is attributable to chronic diseases that are largely preventable

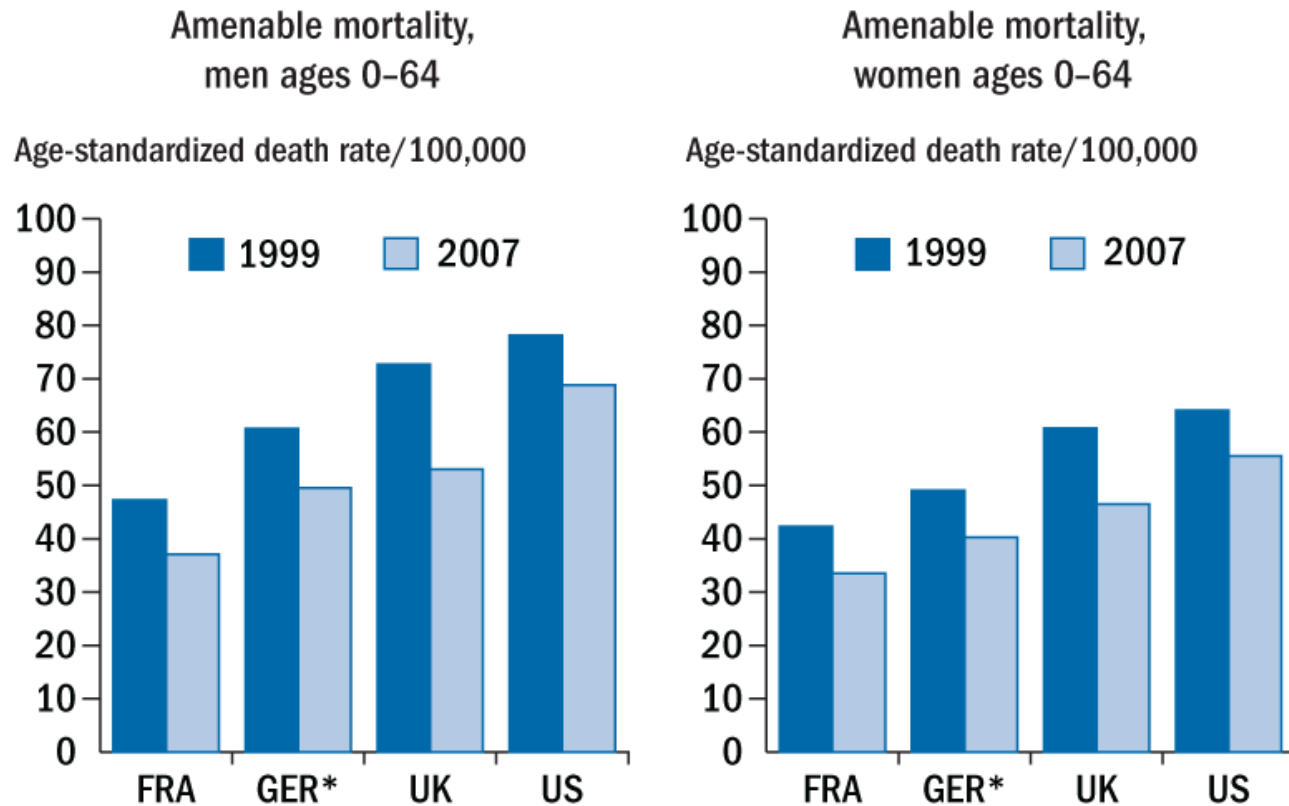
- 80% of cardiovascular disease
- 80% of diabetes
- 60% of lung diseases
- 40% of cancers

(not counting injuries, vaccine-preventable diseases)

<3% of national health spending is allocated to public health and prevention

Preventable mortality in the U.S.

U.S. Men and Women Under Age 65 Have Higher Rates of Potentially Preventable Deaths Slowest Rate of Improvement, 1999–2007

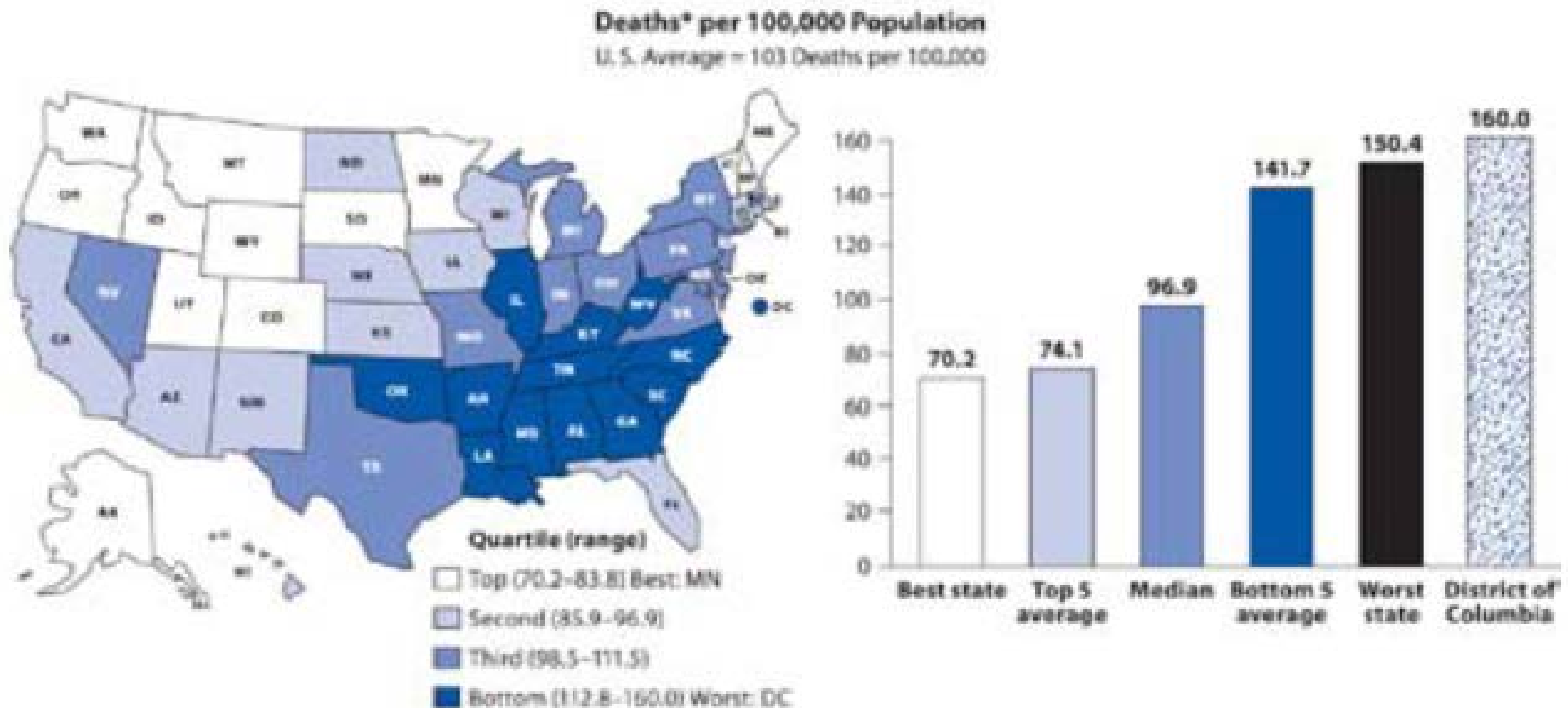


* Data for Germany are 1999 and 2006.

Source: Adapted from E. Nolte and C. M. McKee, "In Amenable Mortality—Deaths Avoidable Through Health Care—Progress in the US Lags That of Three European Countries," *Health Affairs*, published online Aug. 29, 2012.

Source: Commonwealth Fund 2008

Geographic variation in preventable mortality



Public health activities

Organized programs, policies, and laws to prevent disease and injury and promote health on a population-wide basis

- Epidemiologic surveillance & investigation
- Community health assessment & planning
- Communicable disease control
- Chronic disease prevention
- Health education
- Environmental health monitoring and assessment
- Enforcement of health laws and regulations
- Inspection and licensing
- Inform, advise, and assist school-based, worksite-based, and community-based health programming
- ...and legacy of assuring access to medical care

Public health's share of national health spending

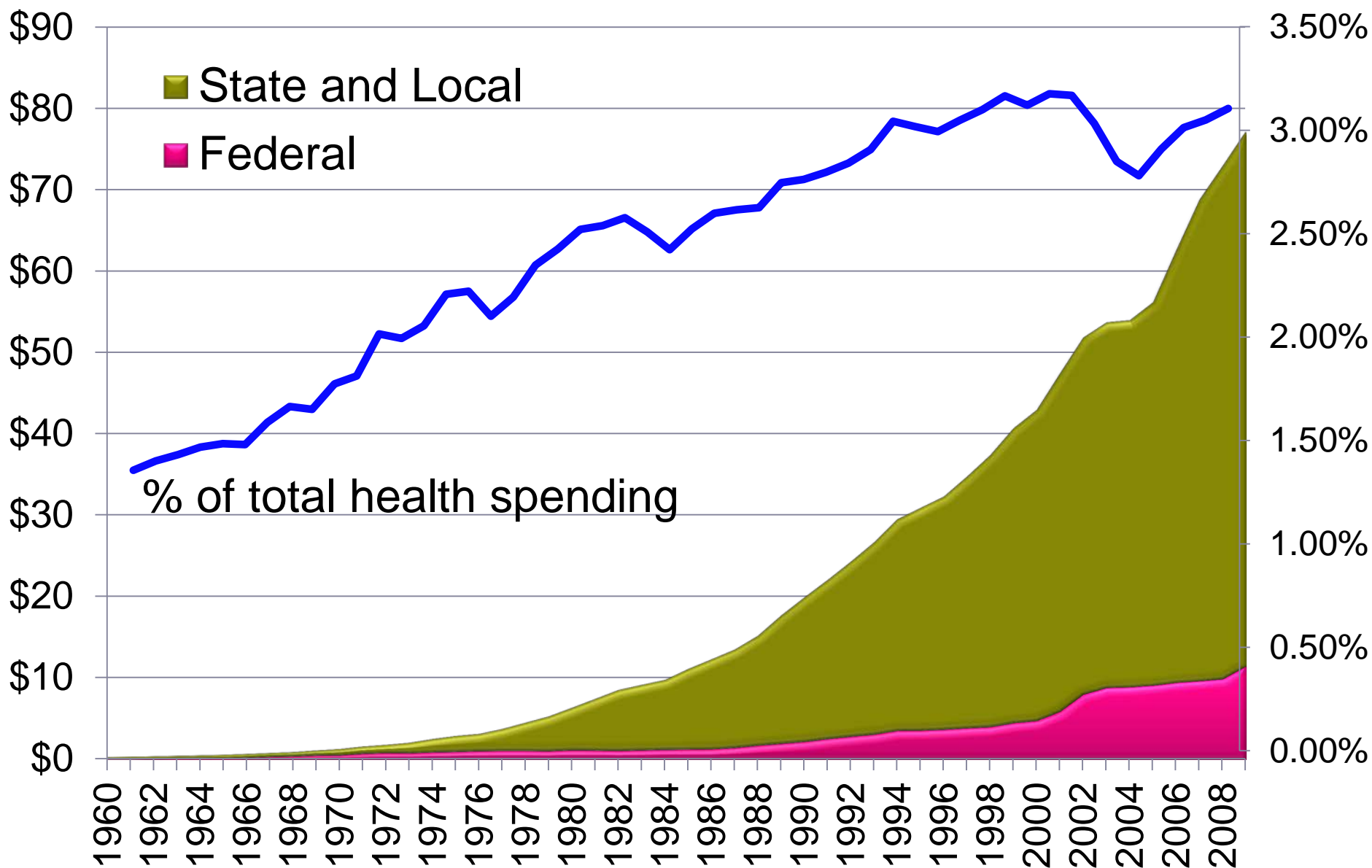
USDHHS National Health Expenditure Accounts

\$Billions

%NHE

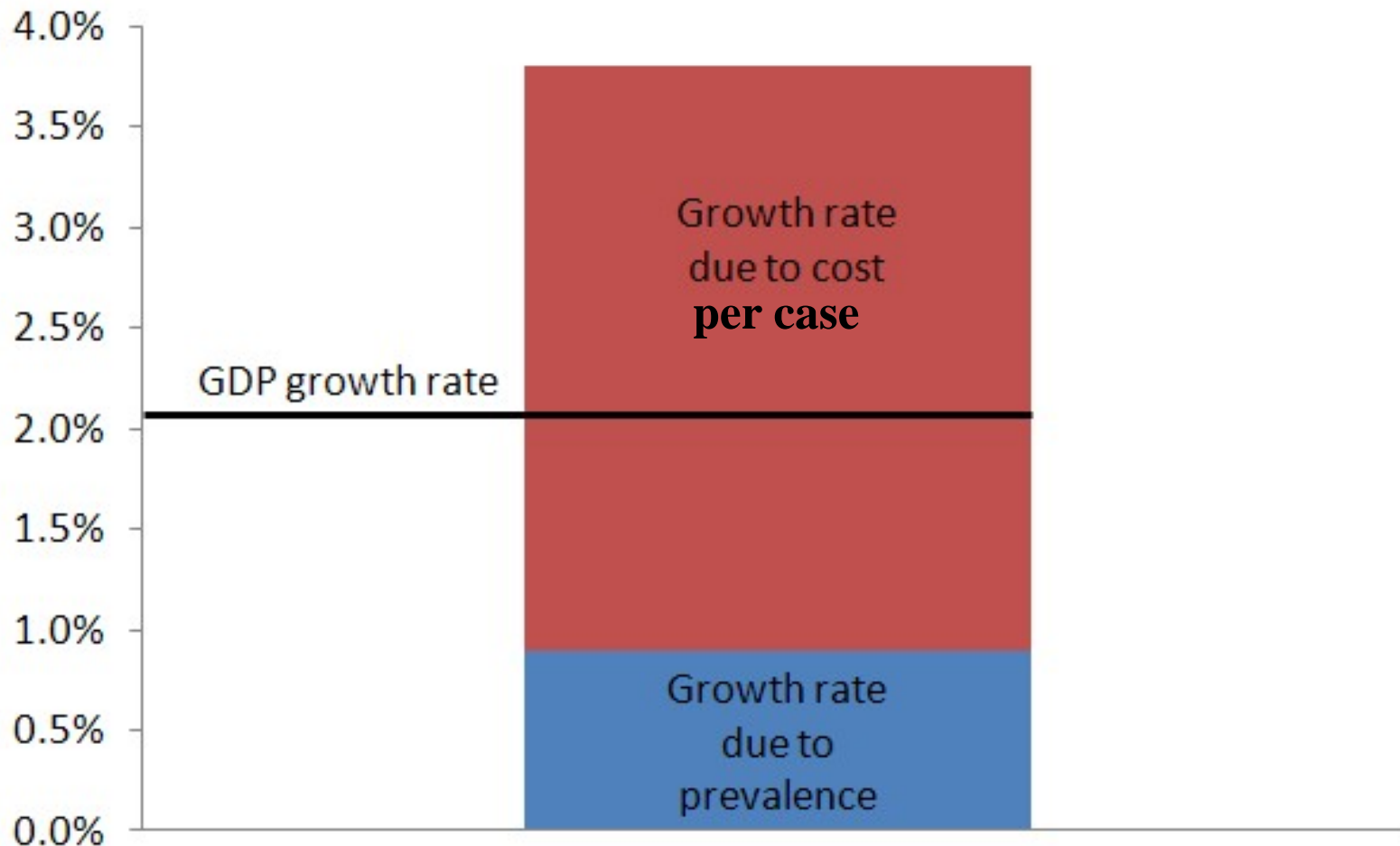
■ State and Local
■ Federal

% of total health spending



Factors driving growth in medical spending

Health spending growth rate 1996-2006



Public Health in the Affordable Care Act

- ◆ \$15 billion in new federal public health spending over 10 years (cut by \$5B in 2012)
- ◆ Public Health and Prevention Trust Fund
- ◆ Incentives for hospitals, health insurers to invest in public health and prevention

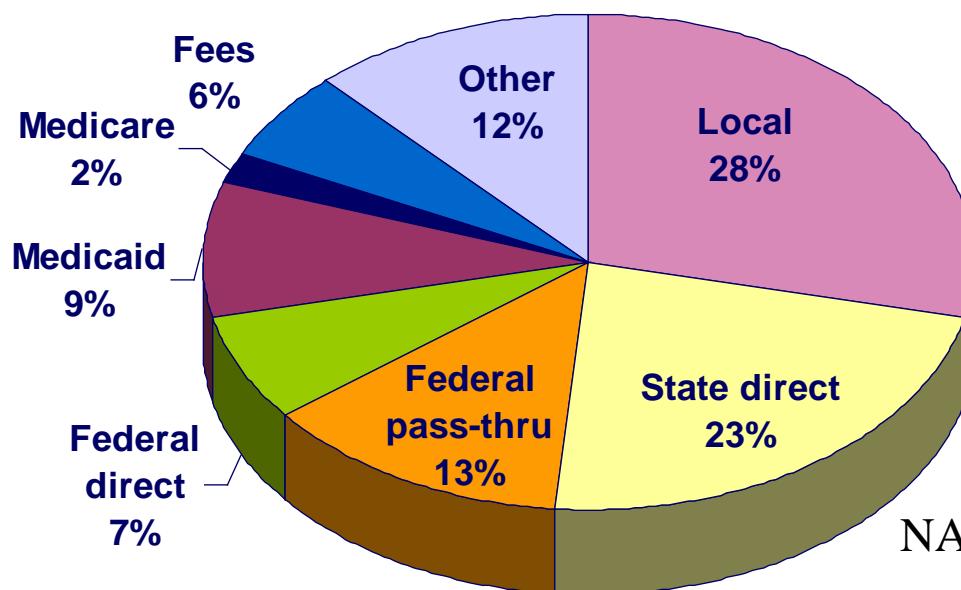
Some research questions of interest...

- ◆ How does *public health* spending vary across communities and change over time?
- ◆ What are the health effects attributable to changes in public health spending?
- ◆ What are the medical cost effects attributable to changes in public health spending?

The problem with public health spending

- ◆ Federal & state funding sources often targeted to communities based in part on disease burden, risk, need
- ◆ Local funding sources often dependent on local economic conditions that may also influence health
- ◆ Public health spending may be correlated with other resources that influence health

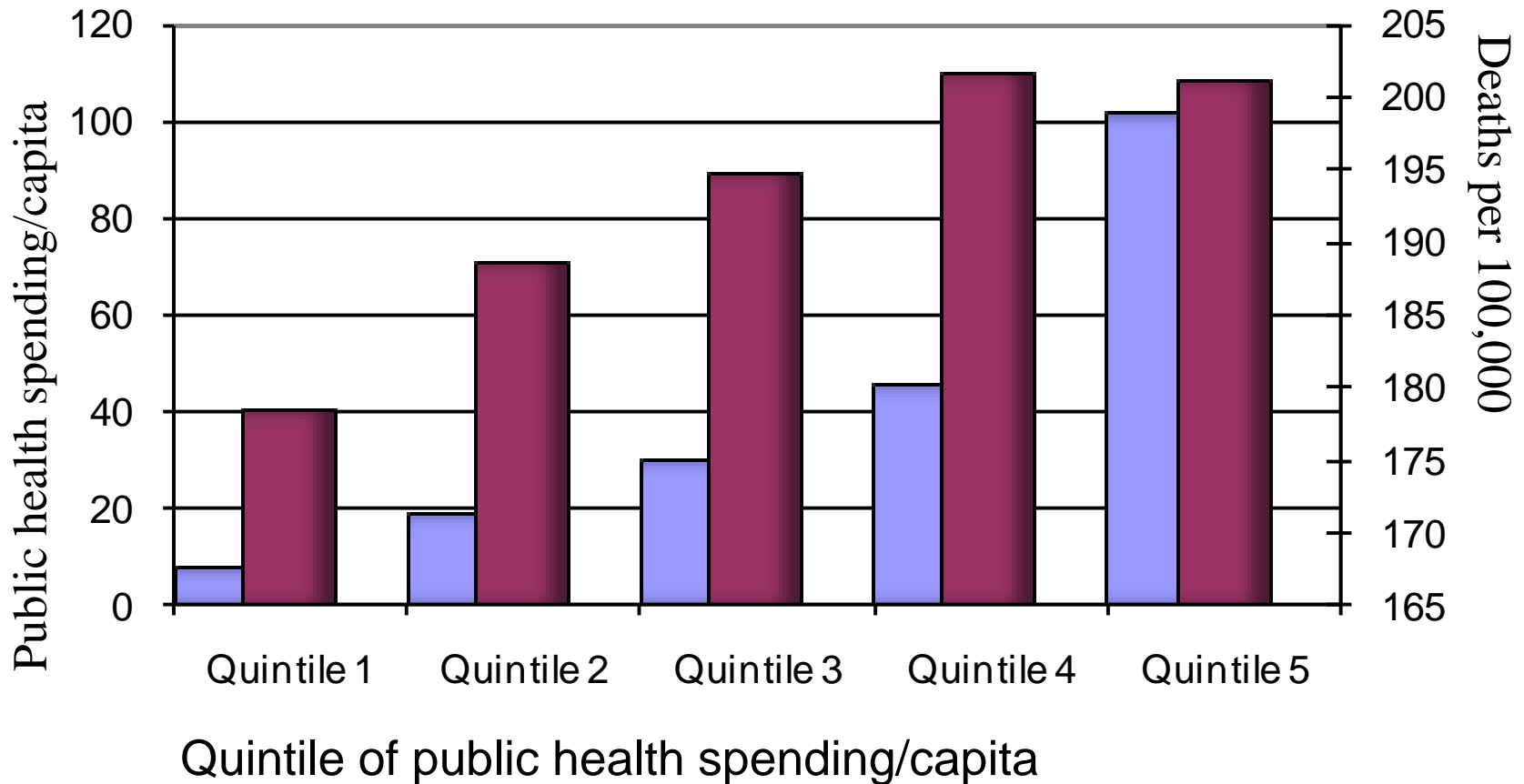
Sources of Local Public Health Agency Revenue, 2005



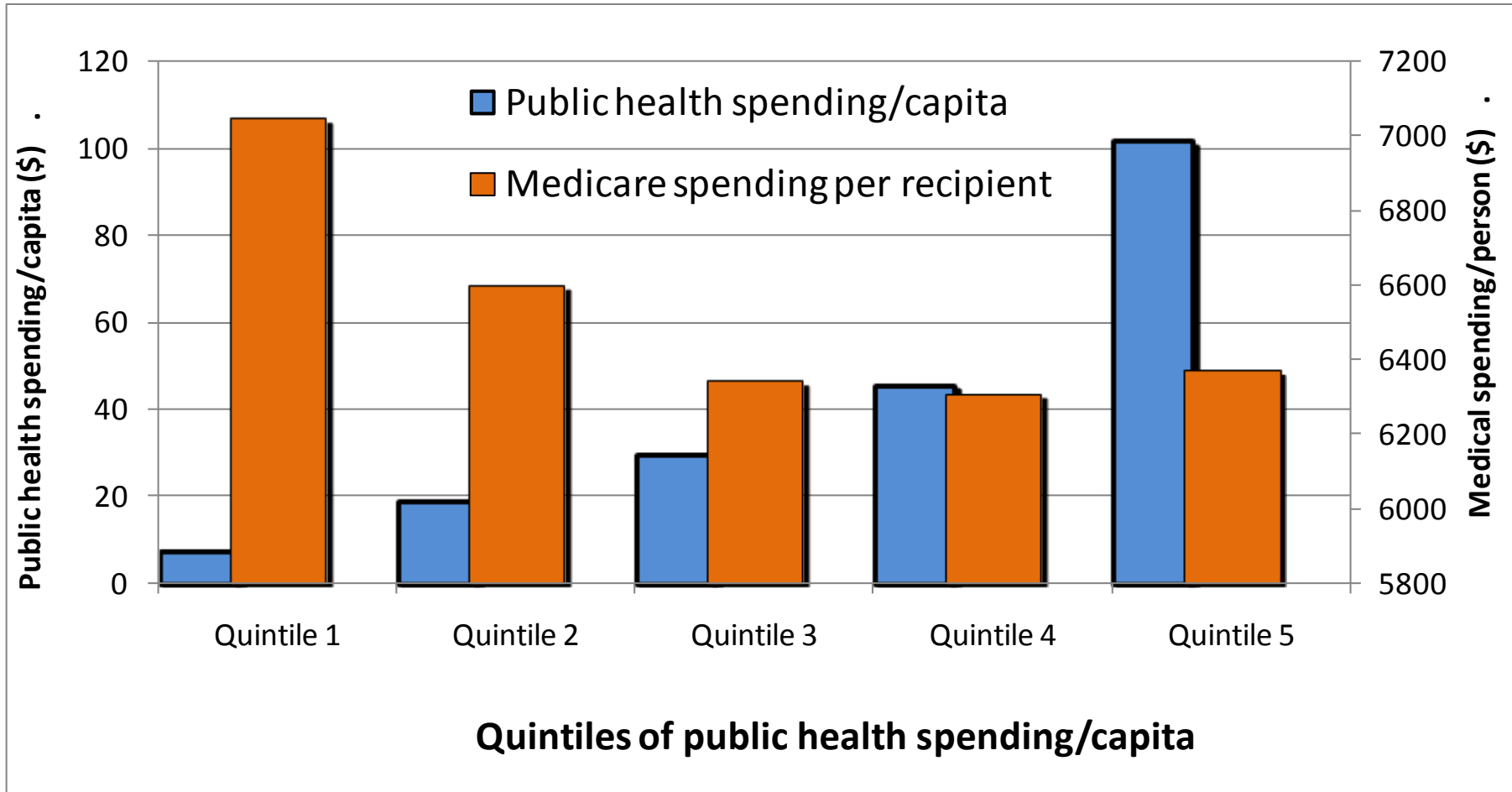
NACCHO 2005

Example: cross-sectional association between PH spending and mortality

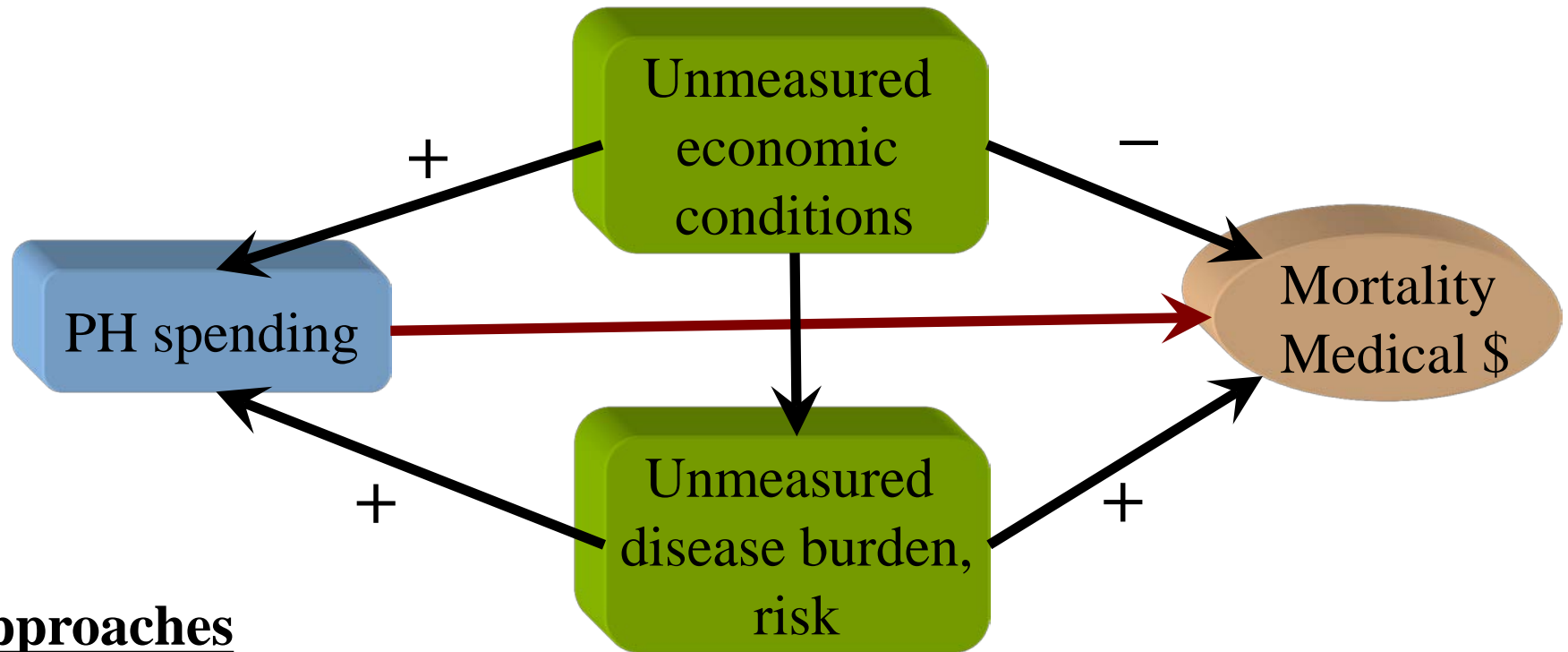
Public health spending/capita
Heart disease mortality



Example: cross-sectional association between PH spending and Medical spending



Analyzing spending effects



Approaches

1. Cross-sectional regression: control for **observable** confounders
2. Fixed effects: also control for **time-invariant**, **unmeasured** differences between communities
3. IV: use exogenous sources of variation in spending
4. Discriminate between causes of death amenable vs. non-amendable to PH intervention

Data used in empirical work

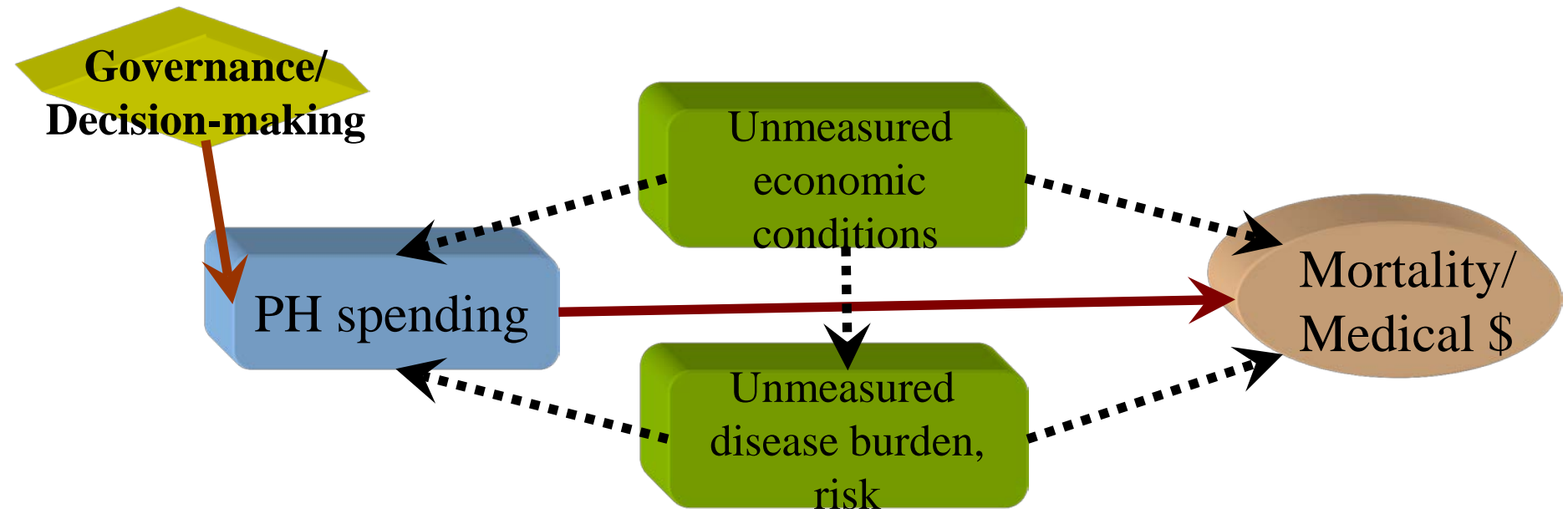
- ◆ NACCHO Profile: financial and institutional data collected on the national population of **local public health agencies** (N≈2800) in 1993, 1997, 2005, 2008, 2010
- ◆ Residual state and federal spending estimates from US Census of Governments and Consolidated Federal Funding Report
- ◆ Community characteristics obtained from Census and Area Resource File (ARF)
- ◆ Community mortality data obtained from CDC's Compressed Mortality File
- ◆ **HSA-level** medical care spending data from CMS and Dartmouth Atlas (Medicare claims data)

Analytical approach

- ◆ Dependent variables
 - Age-adjusted mortality rates, conditions sensitive to public health interventions
 - Medical care spending per recipient (Medicare as proxy)
- ◆ Independent variables of interest
 - Local PH spending per capita, all sources
 - Residual state spending per capita (funds not passed thru to local agencies)
 - Residual federal spending per capita
- ◆ Analytic strategy for panel data: 1993-2008
 - Fixed effects estimation
 - Random effects with instrumental variables (IV)

Analytical approach: IV estimation

- ◆ Identify exogenous sources of variation in spending that are unrelated to outcomes
 - Governance structures: local boards of health
 - Decision-making authority: agency, board, local, state
- ◆ Controls for unmeasured factors that jointly influence spending and outcomes



Analytical approach

- ◆ Semi-logarithmic multivariate regression models used to test associations between spending, service delivery, and outcomes while controlling for other factors

$$\text{Ln}(\text{PH\$}_{ijt}) = \beta \text{Agency}_{ijt} + \delta \text{Community}_{ijt} + \lambda \text{State}_{jt} + \mu_j + \varphi_t + \varepsilon_{ijt}$$

$$\begin{aligned} \text{Ln}(\text{Mortality}_{ijt}) &= \alpha \text{Ln}(\text{PH\$}_{ijt}) \\ &+ \beta \text{Agency}_{ijt} + \delta \text{Community}_{ijt} + \lambda \text{State}_{jt} + \mu_j + \varphi_t + \varepsilon_{ijt} \end{aligned}$$

$$\begin{aligned} \text{Ln}(\text{Medical\$}_{ijt}) &= \alpha \text{Ln}(\text{PH\$}_{ijt}) \\ &+ \beta \text{Agency}_{ijt} + \delta \text{Community}_{ijt} + \lambda \text{State}_{jt} + \mu_j + \varphi_t + \varepsilon_{ijt} \end{aligned}$$

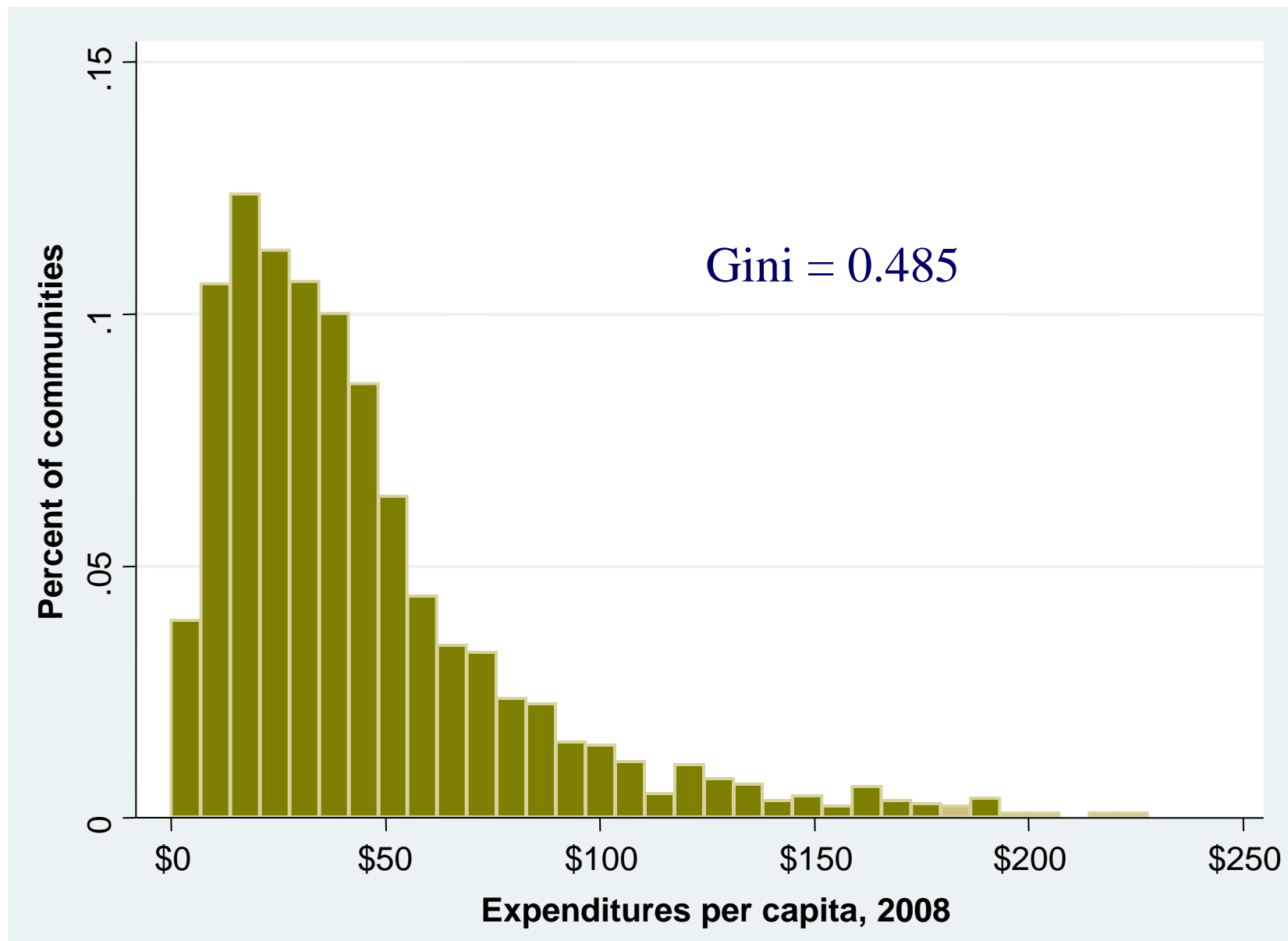
Sensitivity analyses using 1, 3, and 5 year lag structures

Analytical approach

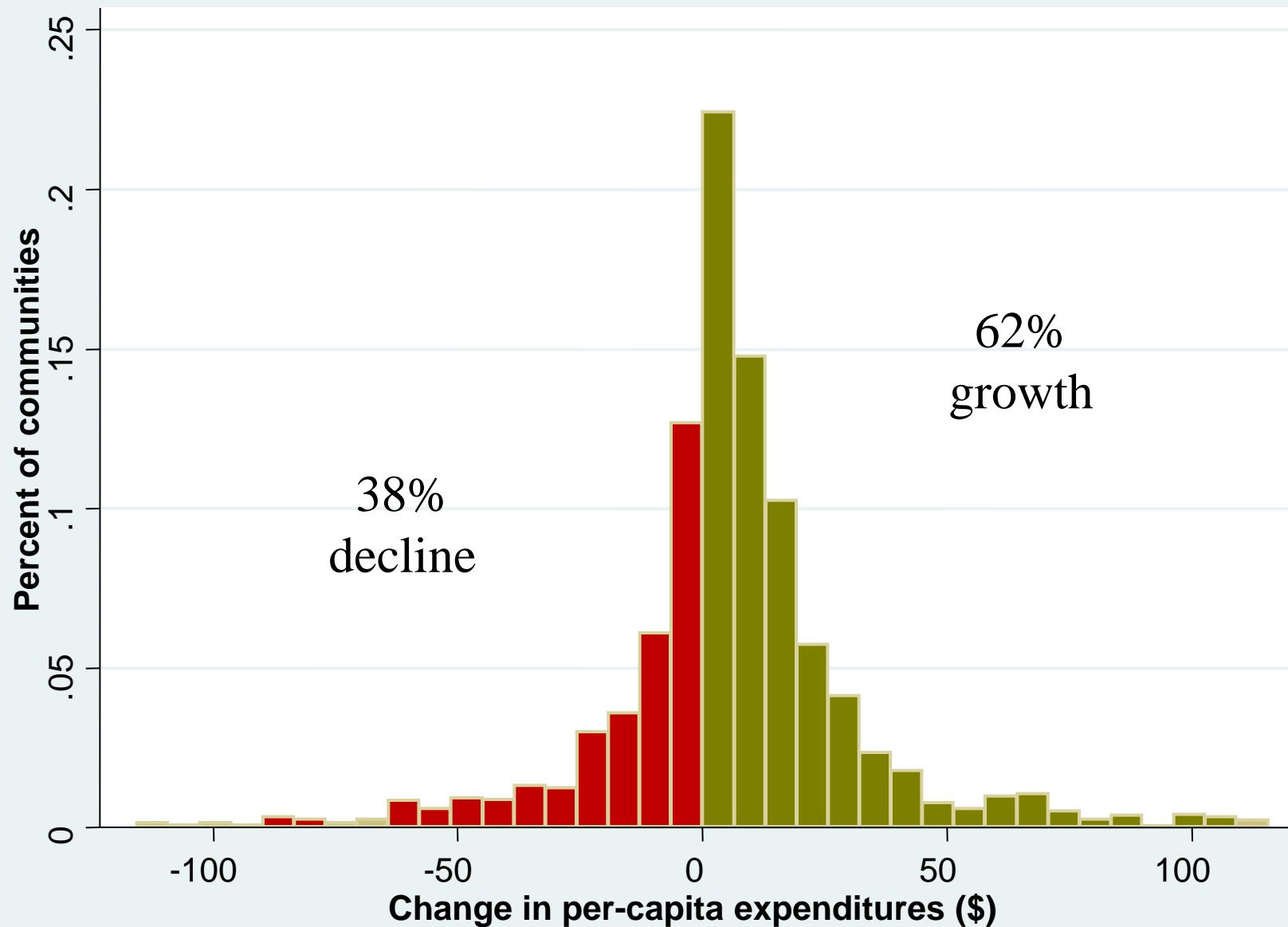
Other Variables Used in the Models

- ◆ ***Agency characteristics***: type of government jurisdiction, scope of services offered, ***local governance and decision-making structures***
- ◆ ***Community characteristics***: population size, rural-urban, poverty, income per capita, education attainment, unemployment, age distributions, physicians per capita, CHC funding per low income, health insurance coverage, local health care wage index
- ◆ ***State characteristics***: Private insurance coverage, Medicaid coverage, state fixed effects

Variation in Local Public Health Spending



Changes in Local Public Health Spending 1993-2008



Determinants of Local Public Health Spending Levels: IVs

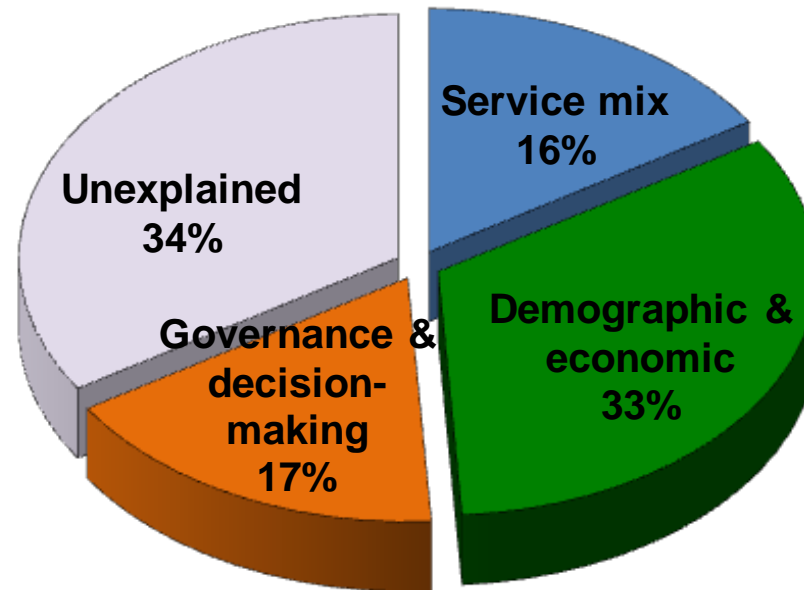
<u>Governance/Decision Authority</u>	<u>Elasticity Coefficient</u>	<u>95% CI</u>
Governed by local board of health	0.131**	(0.061, 0.201)
State hires local PH agency head†	-0.151*	(-0.318, 0.018)
Local govt approves local PH budget†	-0.388***	(-0.576, -0.200)
State approves local PH budget†	-0.308**	(-0.162, -0.454)
Local govt sets local PH fees	0.217**	(0.101, 0.334)
Local govt imposes local PH taxes	0.190**	(0.044, 0.337)
Local board can request local PH levy	0.120**	(0.246, 0.007)

F=13.4 p<0.001

log regression estimates controlling for community-level and state-level characteristics. *p<0.10 **p<0.05 ***p<0.01

†As compared to the local board of health having the authority.

Determinants of Local Public Health Spending Levels



- Delivery system size & structure
- Service mix
- Population needs and risks
- Efficiency & uncertainty

Multivariate estimates of public health spending effects on mortality 1993-2008

	<u>Cross-sectional model</u>		<u>Fixed-effects model</u>		<u>IV model</u>	
<u>Outcome</u>	<u>Elasticity</u>	<u>St. Err.</u>	<u>Elasticity</u>	<u>St. Err.</u>	<u>Elasticity</u>	<u>St. Err.</u>
Infant mortality	0.0516	0.0181 **	0.0234	0.0192	-0.1437	0.0589 ***
Heart disease	-0.0003	0.0051	-0.0103	0.0040 **	-0.1881	0.0292 **
Diabetes	0.0323	0.0187	-0.0487	0.0174 ***	-0.3015	0.0633 **
Cancer	0.0048	0.0029 *	-0.0075	0.0240	-0.0532	0.0166 **
Influenza	-0.0400	0.0200 **	-0.0275	0.0107 **	-0.4320	0.0624 **
Alzheimer's	0.0024	0.0075	0.0032	0.0047	0.0028	0.0311
Residual	0.0007	0.0083	0.0004	0.0031	0.0013	0.0086

log regression estimates controlling for community-level and state-level characteristics

*p<0.10 **p<0.05 ***p<0.01

Effects of public health spending on medical care spending 1993-2008

Change in Medical Care Spending Per Capita Attributable to
1% Increase in Public Health Spending Per Capita

<u>Model</u>	<u>Elasticity</u>	<u>Std. Error</u>
Fixed effects	-0.010	0.002 **
Instrumental variables	-0.088	0.013 **

log regression estimates controlling for community-level and state-level characteristics

*p<0.10 **p<0.05 ***p<0.01

Projected effects of ACA public health spending

- ◆ 10% increase in public health spending in average community:

Public health cost	\$594,291	
Medical cost offset	-\$515,114	(Medicare only)
LY gained	148	
Net cost/LY	\$534	

Conclusions

- ◆ Local public health spending varies widely across communities
- ◆ Communities with higher spending experience lower mortality from leading preventable causes of death
- ◆ Growth in local public health spending appears to offset growth in medical care spending

Implications for Policy and Practice

- ◆ Mortality reductions achievable through increases in public health spending may equal or exceed the reductions produced by similar expansions in local medical care resources
- ◆ Increased federal investments may help to reduce geographic disparities in population health and bend the medical cost curve.
- ◆ Gains from federal investments may be offset by reductions in state and local spending

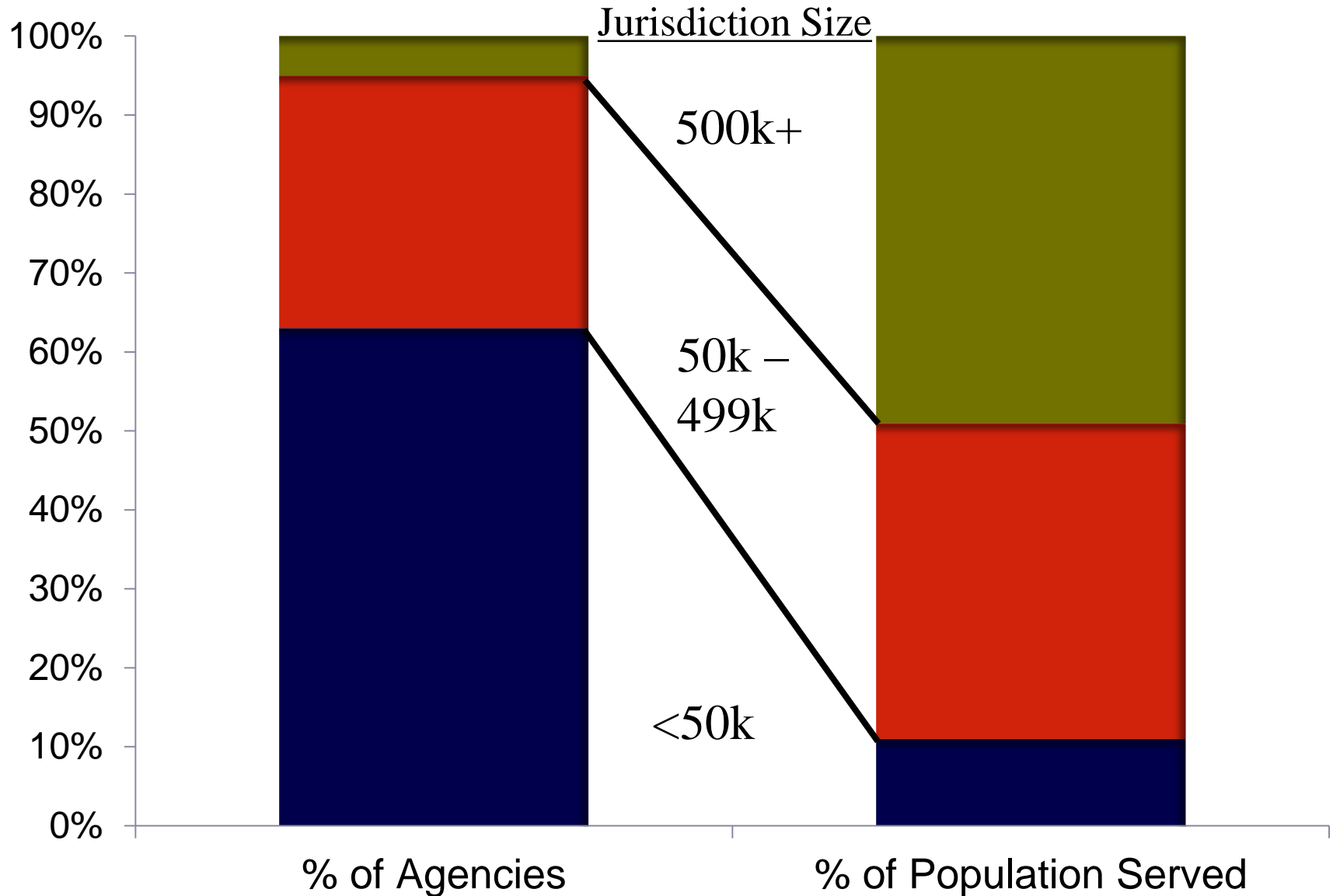
Limitations and next steps

- ◆ Aggregate spending measures
 - Average effects
 - Role of allocation decisions?
- ◆ Mortality – distal measures with long incubation periods
- ◆ Medical care spending relies on Medicare as a proxy measure (20% of total medical \$)
- ◆ Ongoing exploration of lag structures

Some more questions of interest...

- ◆ How can we derive greater value from public health expenditures?
- ◆ Are there economies of scale and scope in the delivery of public health services?
- ◆ Can regionalization improve availability, efficiency & effectiveness of public health services?

Local public health delivery systems



Source: 2010 NACCHO National Profile of Local Health Departments Survey

Sources of Scale and Scope Effects

Economies of Scale

- ◆ Spread fixed costs of public health activities
- ◆ Allow specialization of labor and capital
- ◆ Enhance predictability of infrequent events
- ◆ Pool surge capacity
- ◆ Learn by doing
- ◆ Internalize spill-over effects
- ◆ Network effects

Economies of Scope

- ◆ Use common infrastructure for multiple activities
- ◆ Cross-train workforce
- ◆ Realize synergies across activities
- ◆ Network effects

Analytic Approach

- ◆ Estimate the effects of **scale** (population served) and **scope** (array of activities delivered) on:
 - public health expenditures
 - health outcomes (preventable mortality)
- ◆ Address the potential endogeneity of scope, quality
- ◆ Simulate the effects of regionalizing jurisdictions that fall below selected population thresholds
 - <25,000
 - <50,000
 - <100,000
 - <150,000

Data used in empirical work

- ◆ National Longitudinal Survey of Public Health Systems
- ◆ Cohort of 360 communities with at least 100,000 residents
- ◆ Followed over time: 1998, 2006, 2012
- ◆ Measures:
 - **Scope**: availability of 20 public health activities
 - **Effort**: contributed by the local public health agency
 - **Quality**: perceived effectiveness of each activity
 - **Network**: organizations contributing to each activity
- ◆ Linked with data from NACCHO Profile
 - **Scale**: population size served
 - **Cost**: Local public health agency expenditures
 - Agency characteristics

Data used in empirical work

- ◆ Survey data linked with secondary sources of area characteristics (Census, ARF)
- ◆ Small sample of jurisdictions under 100,000 (n=36) used to evaluate prediction accuracy

Analytical approach

Cost Function Model (semi trans-log)

$$\text{Ln}(\text{Cost}_{ijt}) = \alpha_1 \text{Scale}_{ijt} + \alpha_2 \text{Scale}_{ijt}^2 + \beta_1 \text{Scope}_{ijt} + \beta_2 \text{Scope}_{ijt}^2 + \varphi_1 \text{Quality}_{ijt} + \varphi_2 \text{Quality}_{ijt}^2 + \lambda X_{ijt} + \mu_j + \varphi_t + \varepsilon_{ijt}$$

Instrumental Variables Model

$$\text{Scope}_{ijt} = \theta \text{Network}_{ijt} + \lambda \text{Agency}_{ijt} + \delta \text{Community}_{ijt} + \mu_j + \varphi_t + \varepsilon_{ijt}$$

$$\text{Quality}_{ijt} = \theta \text{Network}_{ijt} + \lambda \text{Agency}_{ijt} + \delta \text{Community}_{ijt} + \mu_j + \varphi_t + \varepsilon_{ijt}$$

IVs: Network: degree centrality, average path length

All models control for type of jurisdiction, governance structure, centralization, population density, metropolitan area designation, income per capita, unemployment, racial composition, age distribution, educational attainment, physician and hospital availability

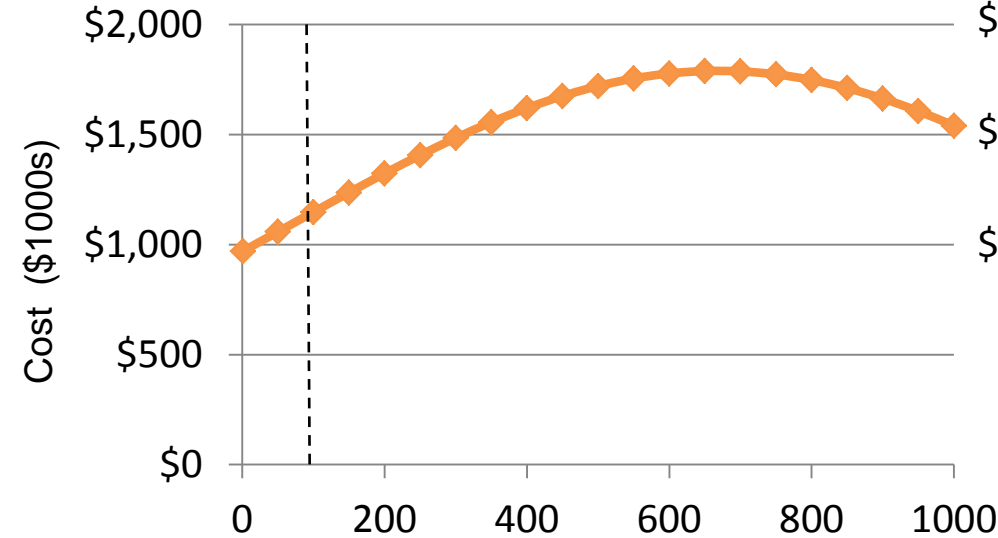
Results: Scale and Scope Estimates

Variable	Partial Elasticity	
	Coeff.	S.E.
Population size	0.0184	0.0029***
Population size squared	-0.0014	0.0002***
Scope	3.89	1.41***
Scope squared	-2.58	0.99***
Quality	-2.98	1.39**
Quality squared	2.72	1.23**

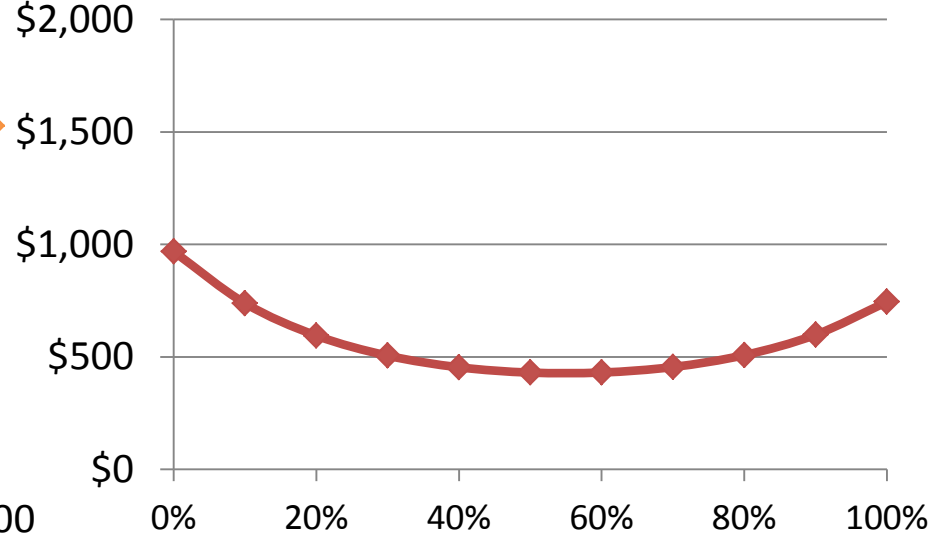
p<0.05 *p<0.01

Results: Scale and Scope Estimates

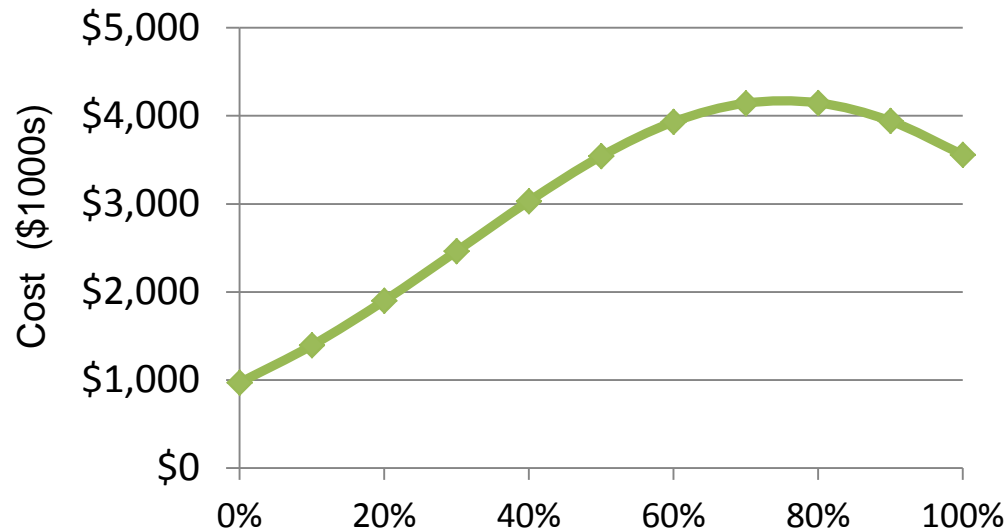
Scale (Population in 1000s)



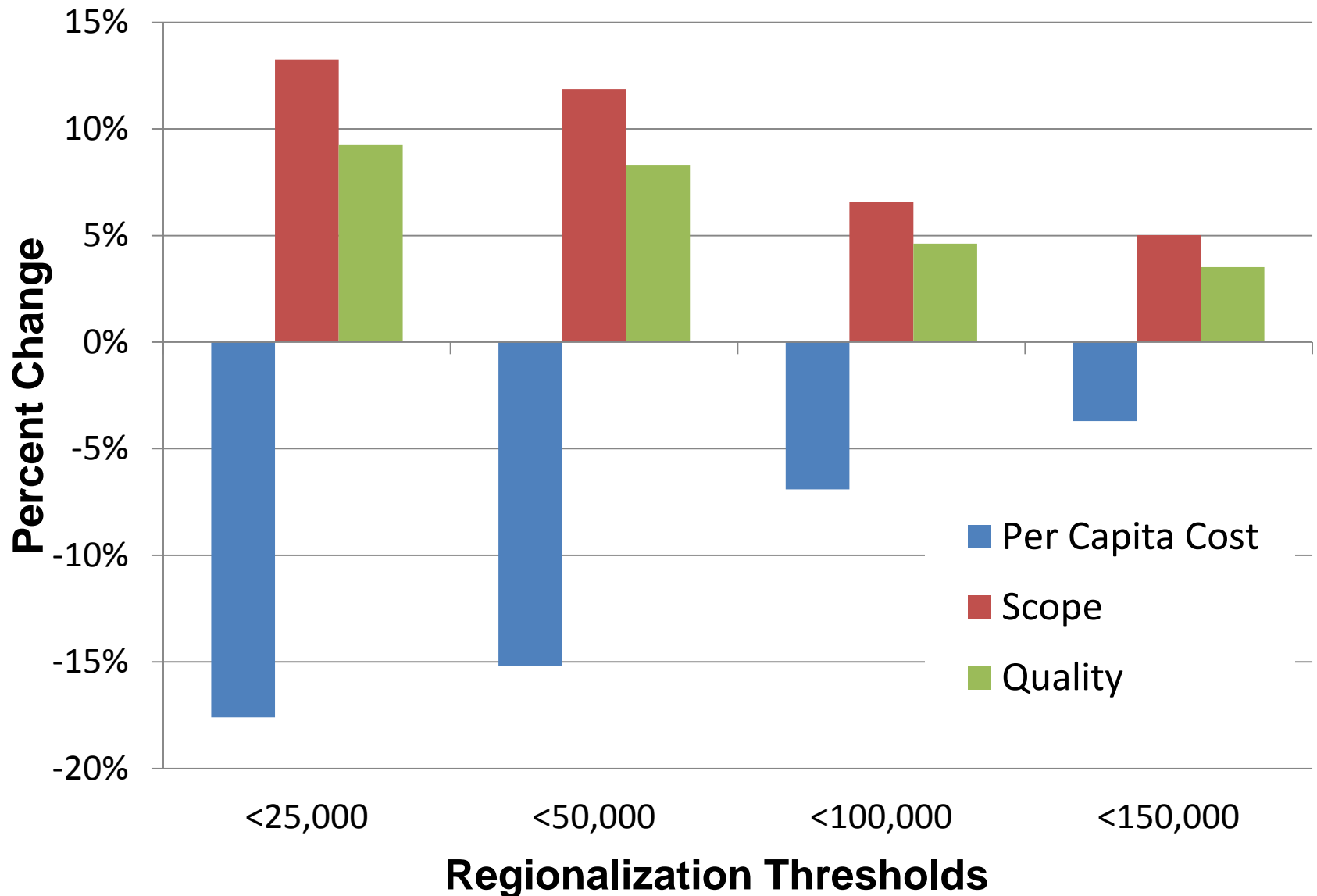
Quality (Perceived Effectiveness)



Scope (% of Activities)



Simulated Effects of Regionalization



Conclusions

- ◆ Significant scale and scope effects are apparent in local public health production
- ◆ Gains from regionalization may accrue through efficiency, scope, and quality
- ◆ Largest regionalization gains accrue to smallest jurisdictions
- ◆ If savings are re-invested in public health production, possibility of important health gains

Limitations and next steps

- ◆ Limited data on small jurisdictions
- ◆ Inability to observe existing “shared service” arrangements
- ◆ Aggregated cost data
- ◆ Lack of data on service volume/intensity