Willingness to bear the costs of preventative public health measures

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Shan Zhang and Trudy Cameron
University of Oregon, Economics Department

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VSL – Value of a Statistical Life

- Many policies and regulations are intended to protect human life and health.
- To analyze the benefits and costs of these measures, we must address society's willingness to pay (WTP) for a variety of health-risk reductions.
- VSL is explained as a marginal rate of substitution between individual private mortality risk and money (i.e., other goods and services)

VSL – Value of a Statistical Life

$$VSL = \frac{MU_r}{MU_Y}$$

- MU_r is the marginal utility of a small reduction in mortality risk.
- MU_Y is the marginal utility of a small change in income.

Empirical data((EPA 2006) estimates VSL in the United States is around **$7,000,000**.

VSL Under a Pandemic

Echazu and Nocetti 2020 "Willingness to pay for morbidity and mortality risk reductions during a pandemic: theory and preliminary evidence from COVID-19"

- The social WTP for a sizeable reduction in infection risk during a pandemic can be quite large, in the range of \$3T to \$7T (15 to 35 % of 2019 U.S. GDP).

Is VSL Enough?

Trudy Ann Cameron 2010 "Euthanizing the Value of a Statistical Life"

Such "one-size-fits-all" VSLs hinder our ability to understand the distributional consequences of risk-reducing policies or interventions. Estimates of aggregate risk reduction benefits need to reflect **the particular type of risk reduction** as well as **the characteristics of the affected populations**.

Question

What's a person's WTP for the health of his/her own community?

- We estimate our model with more county-level variations such as socioeconomic, political, and public health characteristics, in addition to individual preference.
- We calculate the WTP at county-level to capture distributional consequences of risk-reducing policies or interventions.

Benefit Transfer

- This paper constitutes an exercise in "benefits function transfer" **Smith 2002**.
- The "study sample" is an existing survey-based choice experiment fielded to more that 1400 respondents in a representative probability sample of households in counties across the U.S. in 2003 **Bosworth 2009**.
  - original study: determine the social benefits of public health policies to reduce illness and deaths from different types of health threats in the respondent's community.
  - current benefits transfer task: the "policy samples" consist of the populations of all counties across the U.S. during the 2020-21 COVID-19 pandemic.

Literature Review

- **Benefit transfer Methodology:**
  Ready and Navrud 2006; Brander 2007; Lindhjelm and Navrud 2008; Richardson 2015
- **Stated preference and public health policies:**
  Muhlbacher 2016; Cook 2018; Rees-Jones 2020; Chorus 2020
- **Stated preference and pandemic VSL:**
  Li 2020; Reed 2020; Viscusi 2020; Miles 2020; Price 2020; Mitchell-Nelson and Cameron 2021
- **Public health and community engagement:**
  Cattapan 2020; Absul 2020; Amuedo and Dorantes 2020

Benefit Transfer in this paper

We transfer a **benefits function** for the general U.S. population between two different time periods

Estimate for 2003—Predict for 2020/21

Assumptions:

- U.S. preferences over public health policies and net incomes are relatively stable across time
- Differences *across* U.S. counties in 2003 have similar effects on public health policy preferences as do *changes over time* in the characteristics of these U.S. counties

Data

Individual stated-preference survey data

- Online "choice experiments" via premium consumer panel: Knowledge Networks (since GfK, now Ipsos)
- **Bosworth, Cameron and DeShazo (*JEEM*, 2009)** "Demand for environmental policies to improve health: Evaluating community-level policy scenarios"
- A survey instrument designed specifically to elicit individuals' willingness to pay (WTP) for *publicly provided health policies* in 2003

Survey

Example: One randomized policy choice task

Recall that these two policies will be implemented for the 50,000 people living around you.

Would you be most willing to pay for policy A, policy B, or neither of them?

		Policy A	Policy B
(1)		reduces air pollutants that cause heart disease	reduces pesticides in foods that cause adult leukemia
(2)	Policy in effect	over 20 years	over 25 years
(3)	Without policy With policy	1,100 get sick only 100 get sick	30 get sick only 5 get sick
(4)	**Cases Prevented**	**1,000 fewer cases**	**25 fewer cases**
(5)	Without policy With policy	220 will die only 20 will die	6 will die only 1 will die
(6)	**Deaths Prevented**	**200 fewer deaths over 20 years**	**5 fewer deaths over 25 years**
(7)	**Cost to you**	$90 per month (= $1,080 per year for 20 years)	$25 per month (= $300 per year for 25 years)
(8)	**Your choice**	○ Policy A reduces air pollutants that cause heart disease	○ Policy B reduces pesticides in foods that cause adult leukemia
		○ Neither Policy	

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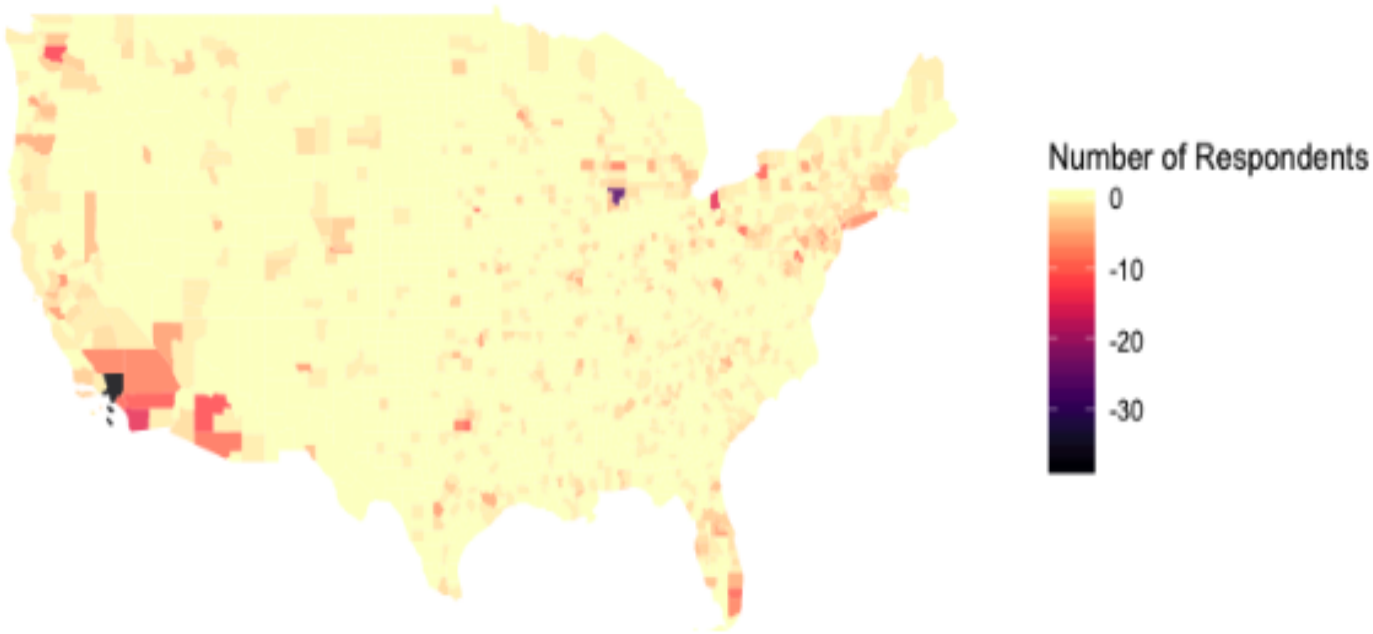
[1] The randomized illness labels include respiratory disease, cancer, leukemia, colon/bladder cancer, asthma, lung cancer, heart disease, heart attack and stroke.

Survey Map



Spatial representativeness: Survey Responses by County

Survey Data Summary Statistics

Public health policy design variables used in choice experiments: 2003 estimating sample

	mean	sd
Pop. affected/county pop.	2.706	8.341
Duration of policy (months)	167.9	116.6
Baseline illnesses	1004.7	2334.5
Number of illnesses avoided	606.9	13854.
Baseline deaths	96.16	472.0
Number of deaths avoided	102.1	467.9
Policies	14466	

Data

Community-level socioeconomic characteristics data

- Ethnic fractionalization (ACS)
- Age distribution (ACS)
- Unemployment rate (BLS)
- Education and income distribution (USDA)
- Presidential election vote shares (Year 2000)

Data

Community-level (county) health characteristics data

- Hospitals/100 sq. miles; hospitals/100,000 population
- Health insurance coverage (SAHIE)
- Primary care physicians rate (CountyHealth Ranking)
- Preventable hospital stays (Ambulatory Care Sensitive Conditions)
- Percentage of smoking, obesity and excessive drinking (CountyHealth Ranking)
- Average PM2.5

County-level data: summary statistics

County-level heterogeneity
2003 estimating sample vs 2020 simulation sample

	2003 Study Sample[a]		2020 Policy Sample[b]	
	mean	(sd)	mean	(sd)
County prop. aged 18-24	0.096	(0.029)	0.086	(0.033)
County prop. aged 65+	0.129	(0.038)	0.193	(0.046)
County prop. White	0.773	(0.168)	0.835	(0.161)
County prop. Black	0.114	(0.129)	0.091	(0.146)
County prop. uninsured	0.160	(0.057)	0.114	(0.050)
County fractionalization (0-1)	0.383	(0.219)	0.280	(0.196)
Rep/(Dem+Rep), Pres. Election	0.511	(0.121)	0.667	(0.161)
County Med. Income	34766.67	(9392.89)	37219	(10592.8)
Hospitals per 10000 population	0.221	(0.338)	0.56	(0.876)
County prop. college degree	0.509	(0.104)	0.524	(0.107)
County overall Poverty	0.124	(0.0433)	0.144	(5.65)
County pm25	11.066	(2.623)	6.59	(1.47)
County prop. Fair or Poor Health	0.158	(0.043)	0.179	(0.047)
Primary Care Physicians Rate	0.906	(0.442)	0.543	(0.034)
Preventable Hospitalization Rate	70.7	(19.4)	48.67	(18.28)
Δ unempl (Jun. '03 vs previous month)	0.678	(0.408)		
Δ unempl (Mar. '20 vs previous month)			0.467	(0.934)
Δ unempl (May. '21 vs previous month)				
Observations	1466 respondents		3142 counties	

[a] Descriptive statistics, across respondents, for the counties in which they reside;
[b] Descriptive statistics across 3142 counties or other county FIPS geographic areas.

Model Specification

- **Indirect utility function under Policy A:**

$$
\begin{aligned}
V_i^A = & \alpha\left(Y_i - c_i^A\right) \\
& + \beta_1 log\left(\Delta illnesses_i^A + 1\right) + \beta_2 log\left(\Delta deaths_i^A + 1\right) \\
& + \beta_3 log\left(baseline\ deaths_i^A + 1\right) \times log\left(\Delta deaths_i^A + 1\right) \\
& + \beta_4 log\left(baseline\ illnesses_i^A + 1\right) \times log\left(\Delta illnesses_i^A + 1\right) \\
& + \beta_5(0) + \epsilon_i^A
\end{aligned}
$$

- **Indirect utility function under status quo:**

$$V_i^N = \alpha\left(Y_i\right) + \beta_5(1)$$

Model Specification

$$V_i^A - V_i^N = \alpha\left(-c_i^A\right) + \Big[\beta_1 log\left(\Delta illnesses_i^A + 1\right)$$
$$+ \beta_2 log\left(\Delta deaths^A + 1\right)$$
$$+ \beta_3 log\left(base\ deaths_i^A + 1\right) \times log\left(\Delta deaths_i^A + 1\right)$$
$$+ \beta_4 log\left(base\ illnesses_i^A + 1\right) \times log\left(\Delta illnesses_i^A + 1\right)$$
$$+ \beta_5(-1)\Big]$$

$V_i^A - V_i^N = 0$, solve for c_i^{A*}

$$WTP(\text{Policy A}) = \frac{[\ldots]}{\alpha}$$

Benefit transfer—Pandemic

- We force the basic policy attributes into the model
- We then interact each of the basics with all of the available county-level data and we subject these interaction terms to LASSO variable selection.
  - Conditional logit choice model (McFadden)
  - Machine learning—LASSO variable selection
  - Use the selected variables to re-run the clogit model

COVID-19 Summary Statistics

Descriptive statistics, county level
2020-21 new cases and deaths

Month	**03/2020** mean/sd	**04/2020** mean/sd	**05/2020** mean/sd	**06/2020** mean/sd	**07/2020** mean/sd
COVID-19 cases	0.58 4.91	2.74 17.28	2.24 11.72	2.62 14.05	5.97 31.05
COVID-19 deaths	0.014 0.16	0.18 1.61	0.13 0.79	0.07 0.39	0.08 0.44
Month	**08/2020** mean/sd	**9/2020** mean/sd	**10/2020** mean/sd	**11/2020** mean/sd	**12/2020** mean/sd
COVID-19 cases	4.54 28.01	3.74 12.01	5.84 16.50	13.50 40.97	19.77 83.00
COVID-19 deaths	0.09 0.46	0.07 0.29	0.07 0.19	0.11 0.30	0.23 0.71
Month	**1/2021** mean/sd	**2/2021** mean/sd	**3/2021** mean/sd	**4/2021** mean/sd	**5/2021** mean/sd
COVID-19 cases	19.11 85.75	7.33 25.84	5.51 19.96	6.05 20.46	2.82 8.79
COVID-19 deaths	0.29 1.42	0.22 1.06	0.12 0.57	0.08 0.36	0.05 0.21
Observations 3142	3142	3142	3142	3142	3142

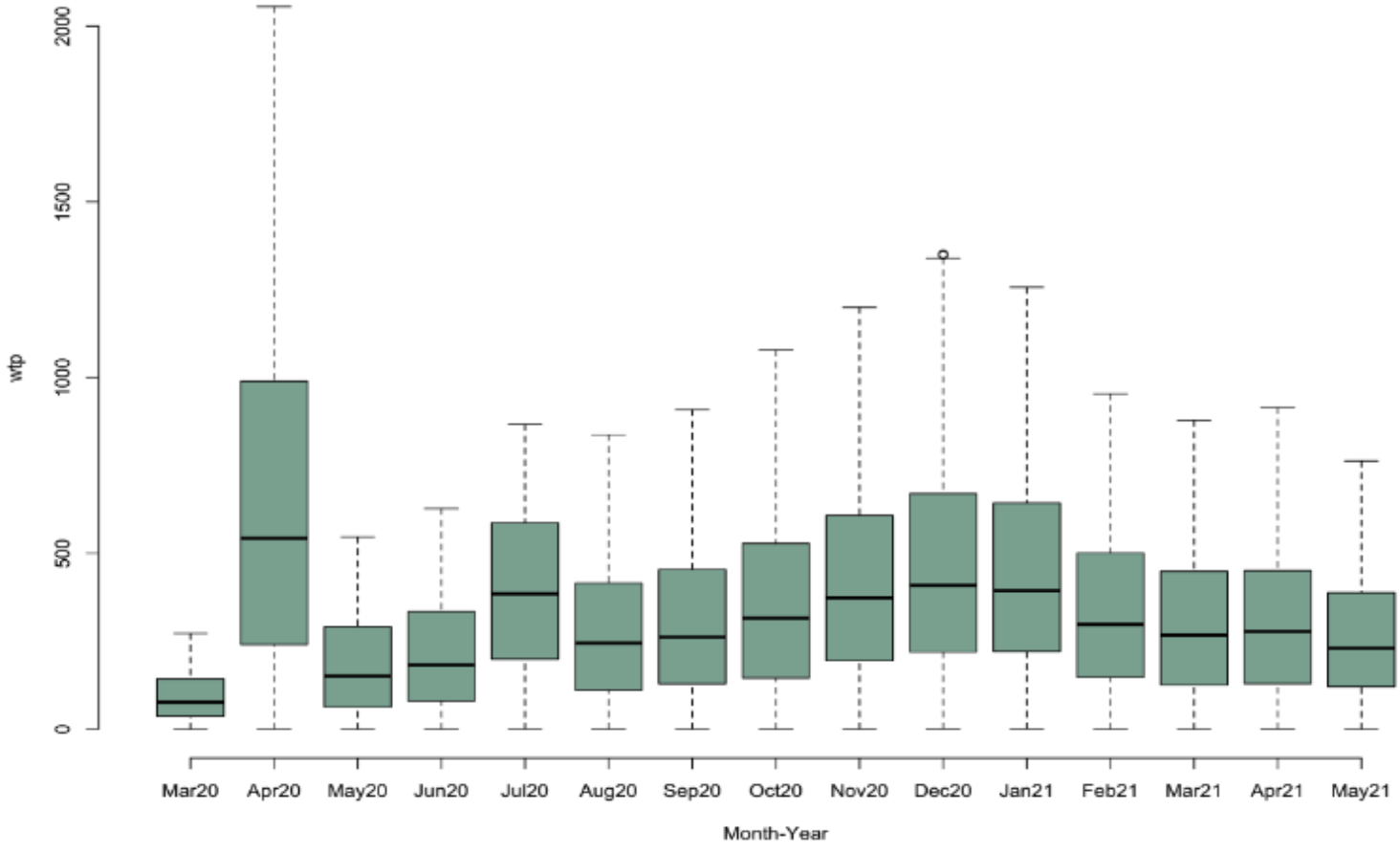
Benefit Transfer

County-level representative individual: Monthly WTP to reduce COVID-19 cases and deaths through 2020-21.

Month	**03/2020** mean/sd	**04/2020** mean/sd	**05/2020** mean/sd	**06/2020** mean/sd	**07/2020** mean/sd
WTP(dollars)	111.19	954.69	230.93	255.78	1084.63
	(483.69)	(5902.04)	(989.29)	(1014.05)	(8863.67)
Month	**08/2020** mean/sd	**09/2020** mean/sd	**10/2020** mean/sd	**11/2020** mean/sd	**12/2020** mean/sd
WTP(dollars)	377.38	453.63	532.97	636.93	693.35
	(1228.37)	(2068.25)	(1834.24)	(2278.77)	(2445.96)
Month	**01/2021** mean/sd	**02/2021** mean/sd	**03/2021** mean/sd	**04/2021** mean/sd	**05/2021** mean/sd
WTP(dollars)	679.62	500.20	432.96	433.46	366.32
	(2830.37)	(2038.80)	(1676.48)	(1691.01)	(1202.98)
Observations	3142	3142	3142	3142	3142

[c] The monthly median WTP to reduce COVID-19 cases and deaths are: Mar20 (0), Apr20 (321.12), May20 (0), Jun20 (6.82), Jul20 (384.86), Aug20 (113.33), Sep20 (164.62), Oct20 (204.56), Nov20 (309.94), Dec20 (342.14), Jan21 (327.46), Feb21 (232.55), Mar21(189.10), Apr21 (180.07), May21(163.82);

Benefit Transfer

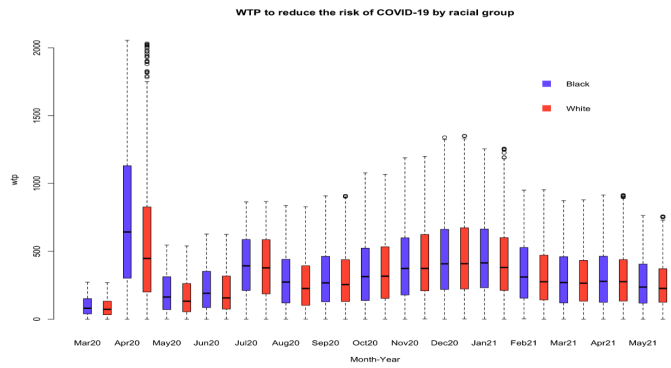


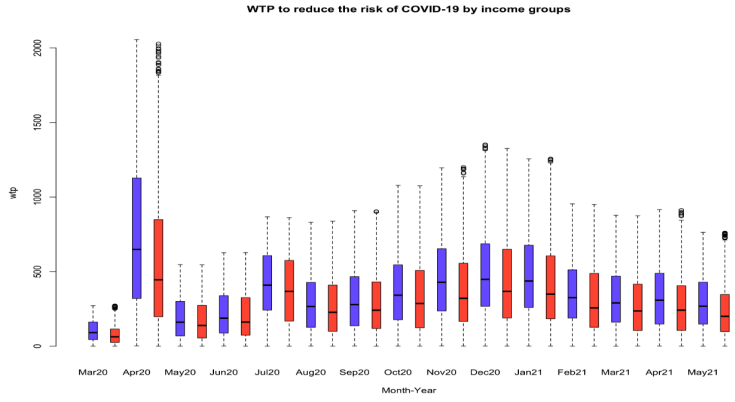
WTP to reduce the risk of COVID-19 across all U.S. counties in 2020-21.

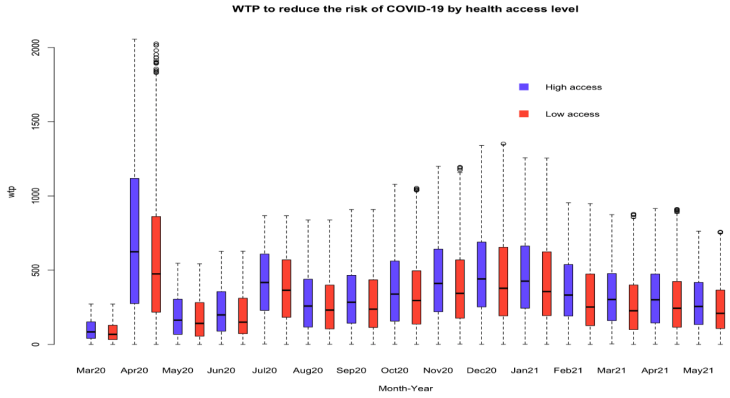
Scaling to monthly total national WTP to avoid COVID-19 cases and deaths

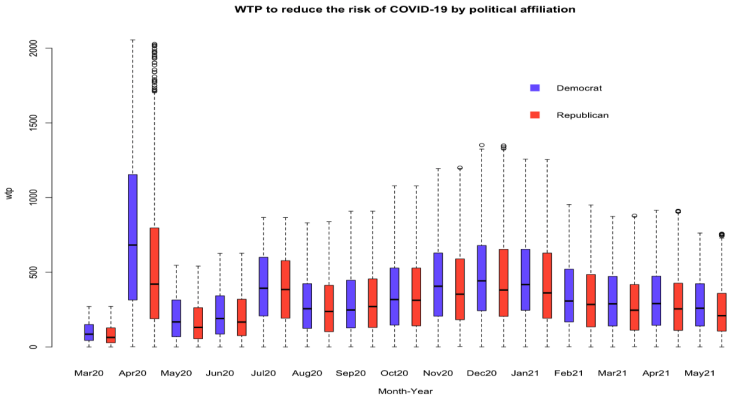
- Scale monthly WTP amounts to a national average for all U.S. adults by weighting these county averages by the population of adults aged 18 and over in each county
- Monthly aggregate WTPs across the whole population of U.S. adults—simply to have avoided the reported cases and deaths— from March 2020 to May 2021 would be: \$123, \$606, \$118, \$125, \$402, \$104, \$130, \$160, \$221, \$253, \$262, \$192, \$174, \$179, and \$154 billion.
  - Most important determinants over time are numbers of cases and deaths, and unemployment rates
- The cumulative U.S. national WTP of all adults over 18 from March 2020 to May 2021 is about **\$3 trillion dollars**

Systematic heterogeneity in predicted WTP to reduce COVID-19 cases and deaths–Sample splits









WTP to reduce the risk of COVID-19 by County Characteristics

Race, income, healthcare access, political party affiliation

Conclusion

- Exploit existing survey responses, re-estimate WTP function, transfer estimated model to the COVID-19 context. Estimate people's 2020-2021 willingness to bear the costs of public health policies to reduce cases, deaths.
- Estimated aggregate national WTP from March 2020 to May 2021 is $\sim$ \$3 trillion, not counting fear of contagion.
- WTP for public health policies to reduce illness and avert deaths is greater for people from counties with higher proportions of adults in labor force and counties with a higher proportion of Black residents. People from counties with higher income and higher health access also tend to have higher WTP to reduce the risks to public health.

Thank you!

szhang6@uoregon.edu