The role of political affinity as an outgroup aversion factor for influencing vaccination rates

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ABSTRACT

Vaccine hesitancy was a major factor impeding the effort to contain the SARS-COV2 (Covid-19) virus. The decision to get a vaccine can be characterized as an innovation adoption action. In a more polarized society, outgroup aversion has been modeled as a factor impacting adoption decisions. Outgroup aversion is when an adoption decision is influenced by identity signaling by ingroups and outgroups to adopt or not adopt a product, idea, or collective action. In this study, we used publicly available information to model the rate of vaccination across the United States at the county level, aggregated by state. Political affiliation was used as a proxy for group membership to understand outgroup characteristics. The anti-vaccination stance and identity signaling by many Republican politicians and news outlets made political affiliation a viable outgroup factor to analyze. Models were generated to understand the role of social vulnerability, vaccine availability, political affiliation, age, and population density. In a majority of states, the strongest predictor for the vaccination rate was the political affiliation variable. One additional finding was that vaccine hesitancy was location-based phenomenon, i.e., national model with over 3000 counties was not as accurate as the individual models by state. At one level these results may be used to understand the outgroup effects on vaccine rates by state to develop mitigation strategies in the future. Additionally, the results also frame the vaccine hesitancy problem as an empirical example to advance our understanding of outgroup aversion effects on innovation adoption.

HYPOTHESES

1. Political affiliation in the form of 2020 voting behavior is a significant factor in vaccination rates by state
2. The influence of political affiliation as a proxy for an outgroup factor differs materially by geography.

The variables from Table 1 were first examined to understand where there were high correlations and then analyzed in Minitab using stepwise general linear model with entry/exit criteria of p-value ranging from .05 to .10 (Minitab Statistical Software, 2010). The data was weighted by county population to avoid over or under representing the percents used as variables. For good measure, variables were standardized to compare magnitudes of the coefficients in terms of influence. Additionally, the data was modeled at both the state and aggregate US level (N = 2836 counties). The model used was:

$$Percent\ vaccinated_{US} = f(CVAC, SVI, RepPercent, AgeOver60, Population\ Density, Ethnicity) \quad (1)$$

Additionally, the state model was similar:

$$Percent\ vaccinated_{State} = f(CVAC, SVI, RepPercent, AgeOver60, Population\ Density, Ethnicity) \quad (2)$$

After running the general linear model, the coefficients were checked for possible multicollinearity by evaluating the Variable Inflation Factor (VIF). VIF was generally considered acceptable if under 3.0.

Table 2: Vaccination variables correlation matrix for US county data (N=2837 to 3142)

Factors	Percent vaccinated	Social Vulnerability Index (SVI)	CVAC level of concern for vaccine	RepPercent	PopDensity	AgeOver60 Percent	Percent Hispanic	Percent n-H Native Am	Percent n-H Asian	Percent n-H Black	Percent n-H Native Hawaiian
Social Vulnerability Index (SVI)	-0.276										
CVAC level of concern for vaccine	-0.402	0.718									
RepPercent	0.015	-0.174	0.025								
PopDensity	0.082	0.02	-0.081	-0.147							
AgeOver60Percent	0.012	-0.283	-0.153	0.164	-0.12						
Percent Hispanic	0.097	0.314	0.324	0.001	0.082	-0.256					
Percent n-H Native Am	0.149	0.168	0.14	-0.078	-0.03	-0.144	-0.042				
Percent n-H Asian	0.267	-0.059	-0.14	-0.245	0.311	-0.24	0.138	-0.018			
Percent n-H Black	-0.254	0.476	0.359	-0.453	0.085	-0.199	-0.116	-0.102	0.017		
Percent n-H Native Hawaiian	0.067	0	0.003	-0.061	0.001	0.066	0.017	0.018	0.376	-0.037	
Percent n-H White	0.042	-0.616	-0.512	0.406	-0.153	0.409	-0.602	-0.293	-0.28	-0.591	-0.11

METHODS

The first step in the analysis was to identify and obtain data from several sources. The data were collected from Centers for Disease Control (CDC), US Census Bureau, and the MIT Election Data and Science project (Centers for Disease Control, 2020a, 2020b; Massachusetts Institute of Technology, 2020; US Census Bureau, 2020). The data were collected at the county level in all cases. Vaccine data by county was not available or not able to link to election data for Texas, Hawaii and Alaska. The data were cleaned up to enable merging on the county identifier. The variables considered are listed in Table 1. The variables selected for inclusion were based on CDC Research on vaccine hesitancy (Social Vulnerability Index (SVI) and Covid Availability Concern (CVAC)). Social Vulnerability Index summarizes the extent to which a community is socially vulnerable to disaster and includes economic data as well as data regarding education, family characteristics, housing, language ability, ethnicity and vehicle access (Agency for Toxic Substances and Disease Registry (ATSDR) & Centers for Disease Control and Prevention, 2018). The Covid-19 Vaccine Coverage Index (CVAC) captures supply and demand related challenges that have prevented vaccine coverage in US counties (Surgo Ventures, 2021). These indexed variables are further explained in Centers for Disease Control and Prevention (2021). Additional variables used that may motivate vaccine use were based on the known characteristics of the virus the vaccine was meant to prevent, i.e., age impacts on the severity of the illness (AgeOver60Percent) and more transmission occurs in a dense population (population density).

Table1: Dependent and independent variables

Variable short name	Description	Variable Type (Source)
Percent Vaccinated	Percent of adults over 18 who are fully vaccinated by county as of 6/21/2021	Independent, quantitative (Centers for Disease Control, 2020b)
County Population	Population of adults over 18	Weighting variable (US Census Bureau, 2020)
Population Density	Population per square kilometer	Dependent, quantitative (US Census Bureau, 2020)
CVAC	Covid vaccine coverage index	Dependent, quantitative (Centers for Disease Control, 2020b; US Census Bureau, 2020)
SVI	Social vulnerability index	Dependent, quantitative (Centers for Disease Control, 2020b)
AgeOver60-Percent	Percent of county population over 60 years old	Dependent, quantitative (Centers for Disease Control, 2020a)
RepPercent	Percent of voters who voted Republican for President in 2020	Dependent, quantitative (Massachusetts Institute of Technology, 2020)
Ethnicity/Race (five variables)	Percent of county population that is non-Hispanic white, black, Asian and Native American; or Hispanic	Dependent, quantitative (Centers for Disease Control, 2020b)

RESULTS

National Results

Table 3: Analysis of Variance for US Covid-19 vaccination rates (all variables) using weighted general linear model weighed by county adult population.

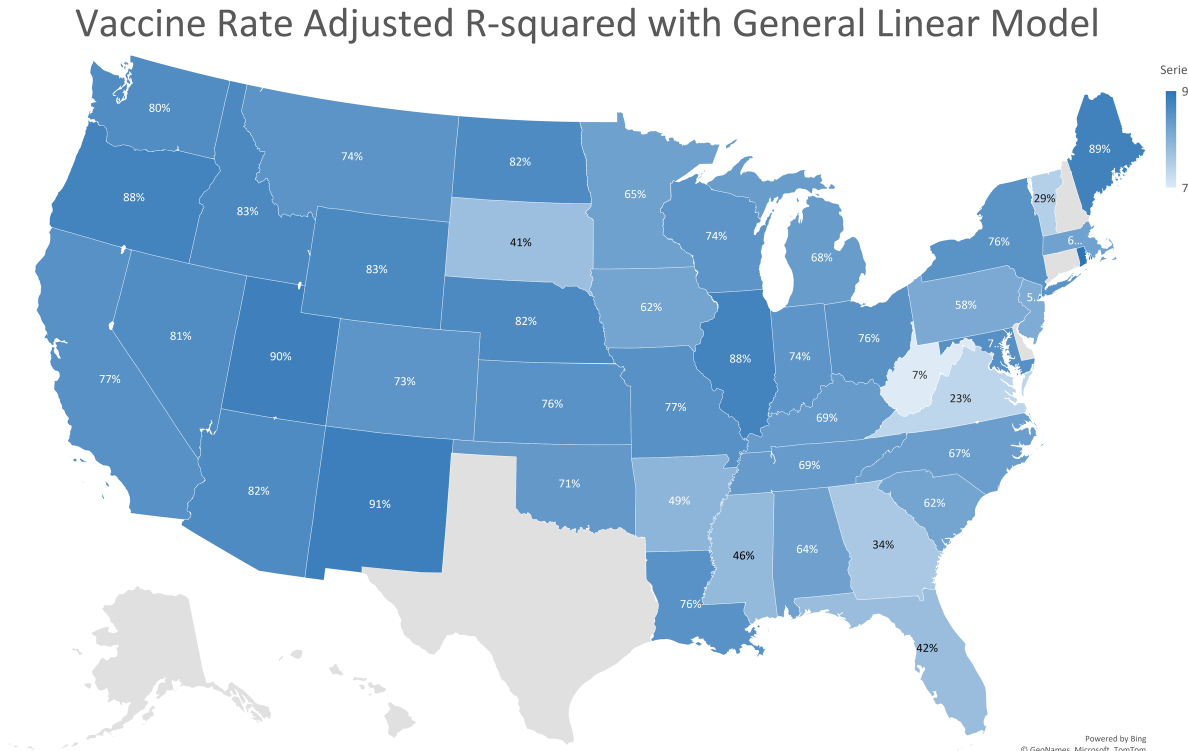
Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
CVAC level of concern for vaccine	1	818847	17.43%	1029135	1029135	1127.75	0.000
Percent Hispanic	1	676272	14.39%	270101	270101	295.98	0.000
Percent n-H American Indian	1	41130	0.88%	58476	58476	64.08	0.000
Percent n-H Asian	1	494910	10.53%	466297	466297	510.98	0.000
Percent n-H Native Hawaiian	1	5767	0.12%	9857	9857	10.80	0.001
AgeOver60Percent	1	79434	1.69%	79434	79434	87.05	0.000
Error	2829	2581620	54.95%	2581620	913		
Total	2835	4697980	100.00%				
R-squared = 45.05%, R-squared (adjusted) = 44.93%							

Table 4: Standardized Coefficients for US Covid-19 vaccination rates, June, 2021

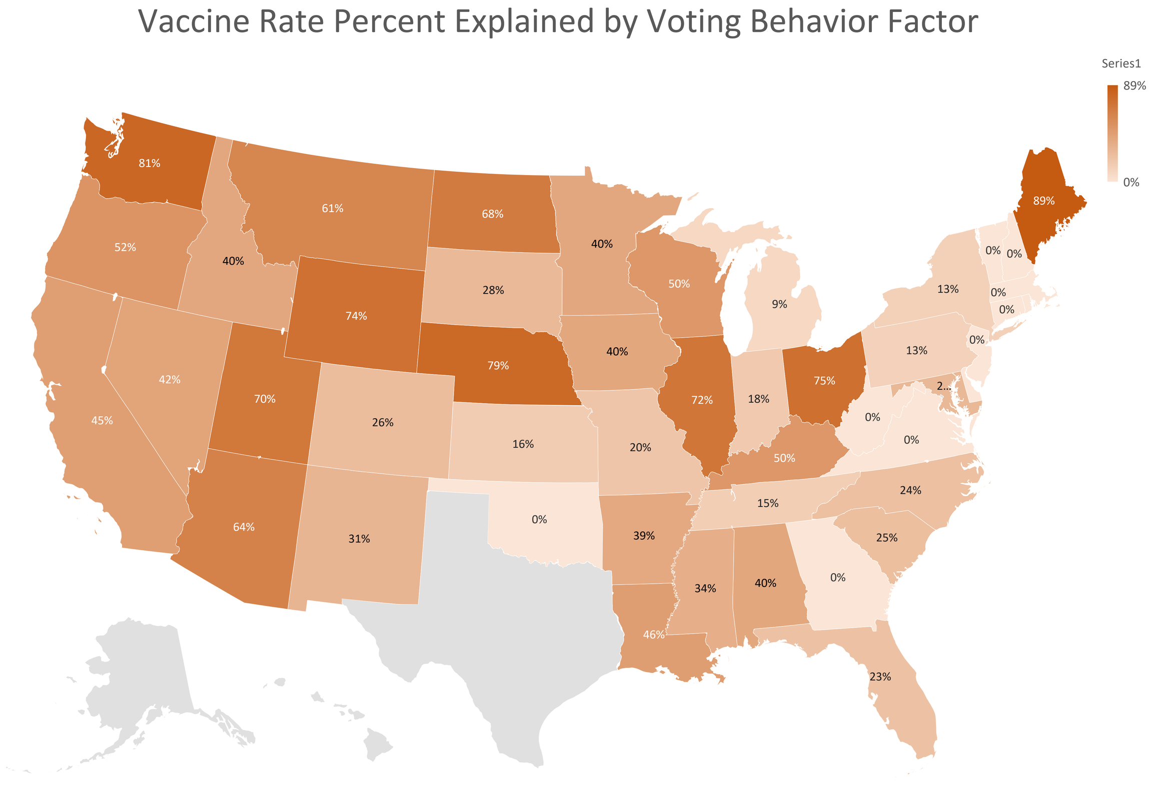
Term	Coef	P-Value	VIF
Constant	0.44159	0.000	
CVAC level of concern for vaccine	-0.07357	0.000	1.33
Percent Hispanic	0.02435	0.000	1.51
Percent N-H American Indian	0.03110	0.000	1.04
Percent N-H Asian	0.019561	0.000	1.45
Percent N-H Native Haw	0.00489	0.001	1.21
AgeOver60Percent	0.02110	0.000	1.21

State Results

Vaccine Rate Adjusted R-squared with General Linear Model



Vaccine Rate Percent Explained by Voting Behavior Factor



CONCLUSIONS AND FUTURE WORK

This research shows that explanations of vaccine rates are much more accurate when the domain for analysis was at a state level. The analysis may help states prioritize efforts between social vulnerability and vaccine availability factors. Later in 2021, efforts to get vaccines to local family doctors were evidence of efforts in the latter category. Efforts to address vaccine decisions influenced by political affiliations may be more challenging. Political affiliation in the form of voters who voted Republican for President in 2020 was a major factor associated with vaccine rates in varying degree by state. While not addressed in this research, the information/misinformation dynamic of political influence that was observed during the vaccination efforts in 2021 would have needed different strategies and tactics to address or to win over high influencers.

This work is not meant to be comprehensive analysis of vaccine hesitation, but to quantify the influence of a group affiliation phenomenon that we call outgroup aversion or ingroup affinity. These terms are used interchangeably because the actual identity signaling may either be not getting a vaccine to be different from the outgroup or refusing a vaccine (at least publicly) to be accepted by the ingroup. That dynamic cannot be determined by this research but may be explored by more surveys or in bottom-up or agent-based models for future study. The contribution of this study is to identify a potential outgroup aversion factor from which to empirically test the various models of outgroup aversion which have not yet been empirically validated (Smaldino et al., 2017). Candidate states for which to consider for such models would include any of the 13 states with a high percent of vaccination rate variability explained by political affiliation.

In a broader sense, this research fits into the framework proposed by Moya, with respect to being a starting point for understanding how people use social information and affiliation to deal with adaptive challenges i.e. vaccination behavior conforms to a social norm in a group-based context (Moya et al., 2020). Differences between states may also be a starting point to understand if the outgroup effects are the result of explicity identity signaling or more covert or encrypted communication (Smaldino, 2022).

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