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Explaining Vaccine Hesitancy: A Covid-19 Study of the United States

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Abstract

Using recent data on the unvaccinated across U.S. states, this paper focuses on the determinants of vaccine hesitancy related to the COVID-19 pandemic. Results show that more prosperous states and states with more elderly and physicians have lower vaccine hesitancy. There was some evidence of the significance of race, but internet access and history of other contagious diseases failed to make a difference. States with centralized health systems and those with mask mandates generally had a lower percentage of unvaccinated populations. Finally, the presence of Democrats in state legislatures tended to result in lower vaccination hesitancies, ceteris paribus.

JEL-Codes: D110, I180, K420.

Keywords: Covid-19, vaccination, vaccine hesitancy, pandemic, government, elderly, race religion, politics, United States.

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1. Introduction

A growing body of academic research has emerged over the past two years focusing on different aspects of the causes and effects of the current pandemic. With respect to the causes or determinants, nearly all of the economic investigations have focused on the socio-economic-political causes of the various containment measures, most notably trying to explain the vaccination disparities across various jurisdictions (Baldwin and Weder di Mauro (2020), Motie and Biolsi (2021)).

With the availability of the different COVID-19-fighting vaccines around the world (https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-(covid-19)-vaccines; also see Kaur and Gupta (2020)) and in order to address the varying vaccination rates around different jurisdictions, the focus of policymakers has shifted to increasing vaccination delivery so herd immunity is achieved and economic and social activities can return to "normal". Increasing the vaccination rates, however, has been a challenge that has turned out to be somewhat beyond the pure economic aspects. In many instances, abundant vaccine supplies and even zero vaccine prices have failed to increase vaccination rates up to saturation rates. Thus, vaccine hesitancy has become a significant policy and debate issue (https://brownstone.org/articles/who-is-to-blame-for-vaccine-hesitancy/).

There is a small body of research that has emerged on vaccine hesitancy (Khubchandani et al. (2021), Norhayati et al. (2022), Sallam (2021), Tan et al. (2022)), focusing on different aspects. Yet, given the varying rates of vaccination success across jurisdictions, policymakers seem to lack formal guidance regarding how to effectively overcome vaccine hesitancy. This present research, focusing on vaccine hesitancy across U.S. states, attempts to provide some insights.[1]

Many influences, including economic, social, health, and political might come to bear upon the decisions to vaccinate and, conversely, to not vaccinate. For instance, Persad et al. (2020) consider the role of race, Sylvester (2021) considers the influence of education, Goel and Nelson (2021a) consider the role of the internet, and Tan et al. (2022) focus on age issues. In addition, the vaccination efforts around the world have become a politically-charged issue and the United States is no different (see da Fonseca et al. (2021), Nayak et al. (2021)). We consider a number of these aspects and details are outlined in the following section and in Table 1.

Interestingly, while healthcare workers, in general, empower states/nations to better administer vaccines, some healthcare workers themselves have shown vaccine hesitancy (Biswas et al. (2021), https://www.theatlantic.com/health/archive/2022/02/home-health-care-covid-vaccination/622029/). We formally evaluate the strength of the influence of health care workers by studying the impact of the number of physicians per capita in a state on vaccine hesitancy.

In the spectrum of the various mitigation and prevention measures against the coronavirus pandemic, some measures like masking and distancing requirements have been implemented from time to time across different U.S. states, while others like lockdowns have not found much public or political support in the United States (see Alfano and Ercolano (2020) for a cross-national study of the efficacy of lockdowns against the spread of COVID-19).

[1] As a practical matter, barring surveying every unvaccinated person, it seems impossible to determine what fraction of the unvaccinated are hesitant as opposed to the fraction of the unvaccinated that are unable to be vaccinated (due to medical or access reasons). We take the share of the population that is unvaccinated to denote vaccine hesitancy.

In order to explain the causes behind differing vaccination rates, this paper formally analyzes the determinants of the unvaccinated. For this purpose, we use recent cross-state data from the United States, considering economic, health, social and political aspects. There are substantial socio-economic-political differences across individual states in the United States, given the federalist nature of the government structure. Thus, the findings should also be of value to other jurisdictions.

Results show more prosperous states and states with more elderly and physicians tended to have lower vaccine hesitancy. There was some evidence of the significance of race factors, but internet access and history of other contagious diseases failed to make a difference. States with centralized health systems and those with mask mandates generally tended to have a lower vaccine hesitancy. Thus, the structure of public health spending mattered more than its mere size (via public health spending). Finally, the increasing presence of Democrats in state legislatures tended to result in lower vaccination hesitancies, ceteris paribus.

The structure of the rest of the paper includes the model, data, and estimation in the next section, followed by results, and conclusions.

2. Model, Data, and Estimation

2.1 Model

With i denoting a state, the general form of our estimated relation, with no vaccination rate in a given state (NOvaccine) as the dependent variable, is

$NOvaccine_i = f(Z_i$, Economic $factors_{ib}$, Health $sector_{im}$, Political $factors_{ij}$, MEXICObor, CANADAbor)…(1)

Where

Z = INCOME, RACE, ELDERLY, RELIGION, PHYSICIANS, MASKS

b = UNEM, EDUC, INTERNET

m = CONTAGIOUSdisease, CentralizedHEALTH, HEALTHspending

j = governorDEM, senateDEM, houseDEM, CORRUPTION

Among the set of explanatory variables that we consider, the vector Z includes determinants that we include in all the models estimated to explain vaccine hesitancy across states in the United States. The choice of the set of Z variables is based on the extant literature (e.g., Baldwin and Weder di Mauro (2020)), plus the plausibility of their expected influence on vaccine hesitancy. These include INCOME, RACE, ELDERLY, RELIGION, PHYSICIANS, and MASKS. INCOME, measured as state median household income, captures the better ability to bear possible adverse consequences of non-vaccination, and income is generally positively correlated with education. Further, more prosperous states would generally have better institutional capacity to vaccinate their populations and to disseminate related information.

The variables RACE, ELDERLY, and RELIGION capture social aspects that are likely relevant in someone's decision to seek or not seek vaccinations,[2] whereas PHYSICIANS is a measure of health capacity, although there has been some hesitancy among healthcare workers to vaccinate (Biswas et al. (2021), https://www.theatlantic.com/health/archive/2022/02/home-

[2] See, for example, https://www.vindy.com/news/local-news/2022/02/vaccine-hesitancy-dips-among-blacks/.

health-care-covid-vaccination/622029/). Vaccine hesitancy among the elderly in Singapore has been studied by Tan et al. (2022). Vaccine hesitancy among the elderly might partly be due to their different risk attitudes (see Caserotti et al. (2021) for a study of risk attitudes and vaccine hesitancy based on Italian data).

Finally, MASKS, identifying states with mandates on wearing masks indoors, can be seen as accounting for related regulations. States with mask mandates are likely to be more proactive towards vaccinating/educating their populations, ceteris paribus.[3]

In addition to INCOME, we also include unemployment (UNEM), education (EDUC), and internet access (INTERNET) as indicators of economic factors that might impact vaccine hesitancy. The unemployed might lack the resources, information, or the incentives to get vaccinated, whereas greater education enables one to better evaluate the pros and cons of vaccinations (in addition to being able to access related information), see Sylvester (2021). Internet access lowers the costs of obtaining information about the costs and benefits of vaccinations, while it might also make one more vulnerable to misinformation.[4]

Beyond accounting for the presence of physicians, we also consider a state's history of infectious diseases (CONTAGIOUSdisease - including HIV diagnoses, Chlamydia, and Lyme Disease (see Table 1)), whether a state's public health system is centralized (CentralizedHEALTH), and a state's per capita health spending (HEALTHspending). A history of other contagious diseases in a state would impact the public's attitudes towards vaccinations to avoid future contagion/pandemics.

[3] Using the theoretical models, Goel and Haruna (2021) evaluate the relative social welfare under mask requirements versus mask recommendations.
[4] Goel and Nelson (2021a) examine the effect of the qualitative nature of internet information (via internet search results) on COVID-19 vaccine delivery.

The other dimensions of the healthcare system enable us to account for the size and structure of government involvement in healthcare. PHYSICIANS and HEALTHspending capture healthcare capacity or size, whereas CentralizedHEALTH captures the structure. A centralized healthcare system would have streamlined decision-making and better coordination, ceteris paribus.

The political inclinations of the executive branch of the state government might impact the willingness and the speed of the government's response to vaccinations (see da Fonseca et al. (2021), Nayak et al. (2021); Potrafke (2018) for a broader related survey; also see https://theconversation.com/politicizing-covid-19-vaccination-efforts-has-fuelled-vaccine-hesitancy-175416). Accordingly, we include three measures: (a) governorDEM is a dummy variable identifying states with a Democrat as a governor; (b) senateDEM is the fraction of a state's senate that is Democrat; and (c) houseDEM is the fraction of the statehouse that is Democrat. The correlation between senateDEM and houseDEM is 0.967.

As an alternative measure of the (weakness of) institutional capacity, we include state corruption (CORRUPTION), measured by convictions of corrupt acts in a state. Vaccination holdouts in states with strict vaccination requirements for entry/travel/employment might view corruption as a means to bypass regulations (Goel and Nelson (2021b)).

Finally, we also account for the geographic location of different states by including variables identifying states bordering Canada and Mexico (CANADAbor and MEXICObor, respectively). Even with international borders largely closed during the pandemic, the casual flow of information and the relatively greater presence of transient populations from neighboring nations (maybe some stuck during the pandemic) might significantly frame vaccination or vaccine-hesitancy attitudes.

2.2 Data

The data used for the analysis consists of a cross-section of the 50 U.S. states plus the District of Columbia. The data are retrieved from various reputable sources—see Table 1 for variable names, definitions, and sources, and Table 2 for corresponding summary statistics.

The main variable of interest is the percentage of the (state) population that has not been fully vaccinated against COVID-19. The Mayo Clinic provides estimates for the percentage of the state's population that has been fully vaccinated. Thus, we compute the percentage of the population not fully vaccinated (NOvaccine) by taking one minus this value. To be considered fully vaccinated individuals must have at least one dose of the Janssen/Johnson & Johnson vaccine or two doses of the Pfizer-BioNTech or the Moderna vaccine.

On average, approximately 37% of the states' population is unvaccinated. However, this average masks the considerable variation in the percentage of the population unvaccinated across states. For instance, Vermont has the smallest percentage of the population unvaccinated (20.5%), while Alabama has the largest share of the population unvaccinated (50.5%).

2.3 Estimation

Turning to a discussion of our estimation strategy, Equation (1) is linearized and then estimated using Ordinary Least Squares (OLS) regression. To mitigate endogeneity resulting from reverse causality, each independent variable is measured in some year preceding the start of the COVID pandemic.

To ensure that OLS is valid, we report several diagnostic tests. First, we report the Cameron and Trivedi's (1990) information matrix (IM) test of the OLS regression model. This test is decomposed into tests for heteroskedasticity, skewness, and kurtosis under the null hypothesis that error is free from heteroskedasticity, skewness, and kurtosis. The test results, reported at the bottom of Table 3, show that we fail to reject the null in all cases, except in Model 3.1 there is some evidence that the errors are heteroskedastic and skewed. As a result, we report heteroskedasticity-robust standard errors for all models.[5]

To check for multicollinearity, we also report variance inflation factors (VIF). The VIFs reported at the bottom of Table 3 are all well below the benchmark ten, suggesting that multicollinearity is not a major concern. The results section follows.

3. Results

3.1 Baseline models

The baseline results in Table 3 show that states with higher median household incomes (INCOME), states with a greater percentage of the elderly (ELDERLY), states with more physicians per capita (PHYSICIANS), and states with mask mandates in indoor spaces (MASKS) all tended to have lower vaccine hesitancy. Whereas INCOME and PHYSICIANS relate to the ability to obtain vaccinations, ELDERLY and MASKS relate more to attitudes towards vaccinations. Quantitatively, the elasticity of NOvaccine with respect to income (Model 3.1), is -0.88 (evaluated at respective means).

We further find that race (RACE - the percent of the state population that is black) tended to have a positive and significant effect on vaccine hesitancy. Beyond differing attitudes towards vaccinations, the positive effect might be partly due to differential access to vaccinations and

[5] Using unadjusted standard errors in place of robust standard errors does not change the statistical significance of the estimated coefficients in any meaningful way.

related information in states with greater concentrations of certain races (see Persad et al. (2020)).

The impact of religion, measured by the share of the population that is of the Christian faith in a state (RELIGION), did not have a significant effect on vaccine hesitancy. Further, the three economic variables, UNEM, EDUC, INTERNET, failed to have a statistically significant impact.[6] This was also the case for the two geographic variables, CANADAbor and MEXICObor, identifying states bordering Canada and Mexico, respectively (Model 3.5).

3.2 Considering aspects of the healthcare sector

In this section, we report results with the consideration of different dimensions of the healthcare sector. While greater healthcare capacity would in general increase vaccination rates, the organization and attitudes of the health sector/employees might contribute to vaccine hesitancy (see https://blogs.bmj.com/bmj/2021/09/10/the-uss-broken-healthcare-system-is-at-the-root-of-vaccine-hesitancy/).

Of the healthcare sector variables reported in Table 4, states with centralized public health systems had a lower vaccine hesitancy, ceteris paribus (Model 4.2). Goel and Nelson (2021b) found the structure of state public health systems in the United States impacts the efficiency of vaccinations, but not vaccine administration.

On the other hand, past history of contagious diseases (CONTAGIOUSdisease) and the size of public health spending in a state (HEALTHspending) failed to have a statistically significant impact on vaccine hesitancy. In other words, states with greater public spending on

[6] A part of the reason for the insignificant sign on INTERNET is likely the high correlation (0.82) it shares with INCOME.

healthcare and those with a greater past prevalence of other contagious diseases were no different from others. The results for the other controls are in general agreement with what was reported in Table 3.

3.3 Considering political influences

The political ideologies of the parties in state legislatures (as well as those of the public) can impact the government's attitudes to the containment of the pandemic (Bilewicz and Soral (2021); also see Holt (2022)).

When we consider the political influences on vaccination hesitancy in Table 5, the results with the Democratic variables (senateDEM and houseDEM), show a negative and significant impact on vaccine hesitancy, implying that states with a greater bent towards the Democratic party tended to have lower vaccine hesitancy. Further, states with a Democrat as a governor (governorDEM) tended to have a lower vaccine hesitancy, with the resulting coefficient statistically significant in two of the four models.

Quantitatively, the elasticities of senateDEM and houseDEM (from Models 5.5 and 5.6, respectively), were quite similar at around -0.18, respectively (both evaluated at their respective means). Although the composition of state legislatures usually changes only gradually (especially in non-election years), these results imply that a ten percent increase in the state house or state senate Democratic membership would lower no vaccination rates by about two percent.

Conversely, the presence of corruption in a state did not significantly affect vaccination hesitancy (Model 5.4).[7] Goel and Nelson (2021b) found corruption to be positively correlated with vaccination rates (with the resulting variable(s) being significant at the 10 percent level).

3.4 Robustness check: Considering no vaccination rates at a different time

Since vaccination rates change over time, and a random date picked for our NOvaccine dependent variable might be correlated with some event (day of the week, holiday, weather, etc.), we redid the analysis in Table 3 with the dependent variable measured at an alternative date. This provides a useful robustness check of our findings and we call the alternative dependent variable NOvaccine2. The correlation between NOvaccine and NOvaccine2 is 0.997**.**

The results again support the baseline findings - INCOME, ELDERLY, PHYSICIANS, and MASKS have negative and statistically significant coefficients, while the coefficients on RACE are positive and (mostly) significant. On the other hand, states with greater literacy, higher unemployment rates, more adherents of the Christian faith, and states with international land borders were no different from others in terms of vaccine hesitancy. Thus, the robustness test with the dependent variable at an alternative date instills confidence in our findings.[8] The concluding section follows.

4. Concluding Remarks

[7] A part of the reason for the lack of significance on the corruption variable might be that corruption convictions are lumpy, with convictions in a given state/year being abnormally low/high.
[8] These results are available upon request.

This paper uses data across U.S. states and contributes to the body of research concerned with the COVID-19 pandemic, by focusing on the determinants of vaccine hesitancy. Besides the social externalities from the unvaccinated, many businesses/organizations are facing challenges to fairly treat their vaccinated and unvaccinated employees https://www.nytimes.com/2021/12/16/us/politics/military-vaccine-mandate.html; https://www.bloomberg.com/news/articles/2022-01-07/citigroup-confronts-vaccine-holdouts-in-no-jab-no-job-mandate). Whereas the issue of vaccine hesitancy has drawn the attention of some scholars (Khubchandani et al. (2021), Tan et al. (2022)), this appears to be the first study that considers a rather large set of determinants of vaccine hesitancy, encompassing economic, social, health, and political aspects.

Results show more prosperous states, states with more elderly, and states with more physicians tended to have lower vaccine hesitancy. In terms of magnitude, a ten percent increase in the number of physicians in a state (per 10,000 state residents) would decrease vaccine hesitancy by about 2.7 percent (Model 3.1, with the elasticity of NOvaccine with respect to PHYSICIANS, evaluated at respective means (see Table 2)). Thus, we did not find evidence of significant vaccine hesitancy across health care workers, at least when captured by the number of physicians (see Biswas et al. (2021)). There was some evidence of the significance of race factors, but internet access and history of other contagious diseases failed to make a difference.

With regard to the direct role of the government,[9] states with centralized health systems (i.e., the structure of public health set up in a state) and those with mask mandates generally

[9] Note that COVID-19 vaccinations are underwritten by the U.S. government for those without health insurance. Thus, that aspect, although another form of direct government involvement to counter the pandemic, is the same across states and, therefore, not formally included in the analysis.

tended to have a lower percentage of unvaccinated populations. Thus, the structure of public health spending mattered more than its mere size (measured via public health spending).

Finally, with regard to political influences, the increasing presence of Democrats in the executives of state legislatures tended to result in lower vaccination hesitancies, ceteris paribus.

The main policy lesson from the analysis is that, whereas a number of economic-health-political influences impact vaccine hesitancy, most of these factors tend to change rather gradually over time. This flies in the face of the relative urgency to vaccinate the masses to achieve herd immunity.

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Table 1: Variable definitions and data sources

Variable	Definition	Source
NOvaccine	The fraction of the selected state's population who are not fully vaccinated. Calculated as one minus the percentage of the population who are fully vaccinated. To be considered fully vaccinated you need to have one dose of the Janssen/Johnson & Johnson vaccine or two doses of the Pfizer-BioNTech or the Moderna vaccine. Date collected: Feb. 3, 2022	[1]
NOvaccine2	NOvaccine collected on date: Feb. 18, 2022	[1]
INCOME	Median household income, measured in thousands of dollars in the year 2019.	[2]
ELDERLY	Fraction of the population that is 65 years and over in the year 2019.	[2]
RACE	Fraction of the population that is Black in the year 2019.	[3]
RELIGION	The percent of the population that is Christian in the year 2010.	[4]
PHYSICIANS	The number of active physicians per 10,000 resident population in the year 2018.	[11]
MASKS	Dummy variable equal to 1 for the eight states that have mask mandates, and zero otherwise. These states require most people to wear a face mask in indoor public places regardless of vaccination status. The eight states include: California, Hawaii, Illinois, Nevada, New Mexico, New York, Oregon, and Washington. Date: December 20, 2021.	[5]
UNEM	Unemployment rate (fraction) in the year 2019.	[2]
EDUC	Fraction of the population 25 years and over with a bachelor's degree or higher in the year 2019.	[2]
INTERNET	Fraction of total households with a broadband Internet subscription in the year 2019.	[2]
CONTAGIOUSdisease	The number of reported cases for HIV diagnoses, Chlamydia, and Lyme Disease as a fraction of the total population in the year 2009.	[6]
CentralizedHEALTH	Dummy variable equal to one if the state's public health is centralized, and zero otherwise (year=2009). The state is considered centralized if all the public health services are administered through a central office.	[7]
HEALTHspending	Direct state and local expenditures for health and hospitals measured in thousands of dollars divided by total population for the year 2019.	[8]
governorDEM	Dummy variable equal to one if the political affiliation of the governor is Democrat and zero otherwise for year 2019.	[9]
senateDEM	Fraction of the state senate that is Democrat for the year 2019.	[9]
houseDEM	Fraction of the state house that is Democrat for the year 2019.	[9]
CORRUPTION	The number of Federal public corruption convictions per 100,000 population. These data were averaged over the years 2017-2019.	[10]
CANADAbor	Dummy variable equal to 1 if state borders Canada and zero otherwise.	
MEXICObor	Dummy variable equal to 1 if state borders Mexico and zero otherwise.	

Data sources:

[1] https://www.mayoclinic.org/coronavirus-covid-19/vaccine-tracker

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Table 2: Summary statistics

	N	Mean	St. dev.	Max	Min
NOvaccine	51	0.374	0.0863	0.505	0.205
NOvaccine2	51	0.366	0.0873	0.500	0.198
INCOME	51	65.511	11.171	92.266	45.792
ELDERLY	51	0.169	0.0202	0.213	0.114
RACE	51	0.127	0.108	0.475	0.00994
RELIGION	51	43.35	11.90	66	9
PHYSICIANS	51	29.73	8.816	74.50	19.60
MASKS	51	0.157	0.367	1	0
UNEM	51	0.0439	0.00878	0.0660	0.0260
EDUC	51	0.327	0.0654	0.597	0.211
INTERNET	51	0.858	0.0314	0.912	0.768
CONTAGIOUSdisease	50	0.00403	0.00151	0.0102	0.00195
CentralizedHEALTH	50	0.160	0.370	1	0
HEALTHspending	51	0.890	0.498	2.978	0.174
governorDEM	50	0.460	0.503	1	0
senateDEM	50	0.462	0.218	1	0.100
houseDEM	49	0.476	0.192	0.900	0.150
CORRUPTION	51	0.298	0.399	2.366	0
CANADAbor	51	0.255	0.440	1	0
MEXICObor	51	0.0784	0.272	1	0

Note: See Table 1 for variable definitions.

Table 3: Explaining vaccine hesitancy: Baseline models

Dependent variable: NOvaccine

	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)
INCOME	-0.005***	-0.004***	-0.004**	-0.006***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
ELDERLY	-1.643***	-1.629***	-1.668***	-1.651***	-1.751***
	(0.380)	(0.383)	(0.388)	(0.397)	(0.380)
RACE	0.131*	0.118	0.132*	0.149**	0.122*
	(0.065)	(0.074)	(0.066)	(0.066)	(0.067)
RELIGION	-0.000	-0.000	-0.000	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PHYSICIANS	-0.003**	-0.004**	-0.003	-0.003*	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
MASKS	-0.035*	-0.037**	-0.038**	-0.030*	-0.028
	(0.018)	(0.018)	(0.018)	(0.016)	(0.017)
UNEM		0.275			
		(0.970)			
EDUC			-0.221		
			(0.300)		
INTERNET				0.451	
				(0.478)	
CANADAbor					0.004
					(0.015)
MEXICObor					-0.033
					(0.027)
Diagnostic tests					
Heteroskedasticity test	[0.070]	[0.277]	[0.222]	[0.179]	[0.213]
Skewness test	[0.089]	[0.138]	[0.125]	[0.479]	[0.187]
Kurtosis test	[0.983]	[0.965]	[0.719]	[0.995]	[0.907]
Total	[0.042]	[0.201]	[0.151]	[0.237]	[0.175]
Mean VIF	1.71	2.01	3.15	2.97	1.66
Observations	51	51	51	51	51
R-squared	0.771	0.772	0.775	0.776	0.781

Notes: See Table 1 for variable details. Each model is estimated using OLS with robust standard errors is in parentheses and probability values in brackets. Constant is included in each model but not reported. Asterisks denote the following significance levels: *** p<0.01, ** p<0.05, and * p<0.1.

Table 4: Explaining vaccine hesitancy: Controlling for health sector factors

Dependent variable: NOvaccine

	(4.1)	(4.2)	(4.3)
INCOME	-0.004***	-0.003***	-0.004***
	(0.001)	(0.001)	(0.001)
ELDERLY	-1.599***	-0.733*	-1.557***
	(0.391)	(0.374)	(0.372)
RACE	0.070	0.113**	0.108
	(0.074)	(0.052)	(0.066)
RELIGION	-0.000	0.000	-0.000
	(0.001)	(0.001)	(0.001)
PHYSICIANS	-0.004**	-0.007***	-0.003**
	(0.002)	(0.001)	(0.002)
MASKS	-0.041**	-0.028**	-0.039*
	(0.019)	(0.013)	(0.020)
CONTAGIOUSdisease	6.805		
	(6.392)		
CentralizedHEALTH		-0.043***	
		(0.014)	
HEALTHspending			0.018
			(0.016)
Observations	50	50	51
R-squared	0.767	0.850	0.781

Notes: See Table 1 for variable details. Each model is estimated using OLS with robust standard errors is in parentheses. Constant is included in each model but not reported. Asterisks denote the following significance levels: *** p<0.01, ** p<0.05, and * p<0.1.

Table 5: Explaining vaccine hesitancy: Controlling for political factors

Dependent variable: NOvaccine

	(5.1)	(5.2)	(5.3)	(5.4)	(5.5)	(5.6)
INCOME	-0.003***	-0.003***	-0.003***	-0.003***	-0.002**	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ELDERLY	-0.596	-0.856**	-0.859**	-0.967***	-0.477	-0.599
	(0.388)	(0.364)	(0.331)	(0.324)	(0.350)	(0.385)
RACE	0.125**	0.068	0.079	0.100*	0.138**	0.138**
	(0.052)	(0.065)	(0.059)	(0.056)	(0.053)	(0.052)
RELIGION	0.000	0.000	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PHYSICIANS	-0.007***	-0.007***	-0.007***	-0.007***	-0.005***	-0.005***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
MASKS	-0.012	-0.022	-0.023	-0.018	0.002	-0.001
	(0.014)	(0.019)	(0.019)	(0.017)	(0.020)	(0.016)
governorDEM	-0.026**	-0.024	-0.023	-0.024*		
	(0.013)	(0.014)	(0.014)	(0.013)		
CentralizedHEALTH	-0.045***				-0.019	-0.027*
	(0.013)				(0.017)	(0.015)
CONTAGIOUSdisease		2.555				
		(4.837)				
HEALTHspending			0.010			
			(0.013)			
CORRUPTION				0.032		
				(0.023)		
senateDEM					-0.153**	
					(0.062)	
houseDEM						-0.139**
						(0.052)
Observations	50	49	50	50	49	49
R-squared	0.866	0.826	0.837	0.843	0.872	0.872

Notes: See Table 1 for variable details. Each model is estimated using OLS with robust standard errors are in parentheses. Constant is included in each model but not reported. Asterisks denote the following significance levels: *** p<0.01, ** p<0.05, and * p<0.1.