LUISS

Department
of Business and Management

Course of Applied Statistics and Econometrics

In opioids we (do not) trust: Evidence from US counties

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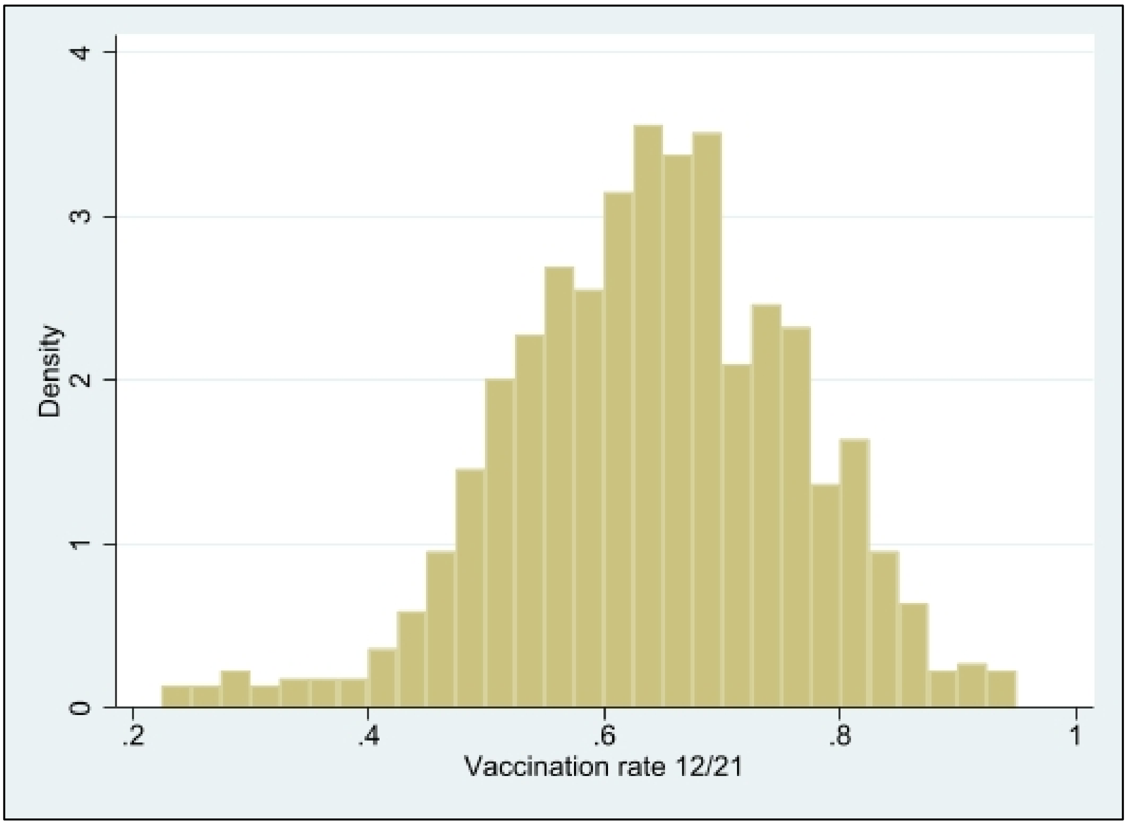
1. Introduction

The main focus of our research is the relationship between trust, the recent pandemic of Covid-19 and the rising trend in opioids abuse. The main question concerns how trust in institutions can influence Americans' decision making when faced with the choice of whether or not to vaccinate. Believing that institutions are trustworthy is stunningly important, especially since the vast majority is not trained enough to understand how vaccines are produced and the techniques laying behind this discovery. We decided to focus on trust in the governmental health care system involved in vaccination: Federal Drug Administration (FDA). We then asked ourselves which elements influenced trust in institutions and how we could measure them. As shown in recent research (Giulietti et al.) some factors like Covid19-related deaths influence vaccination, especially at a local level for minority groups. The main element we were interested in analyzing was opioids abuse. Data show a recent upward trend in opioid-related deaths, mainly due to overdose. Our argument develops canonically: if a person dies of overdose caused by an approved drug, then the people who live nearby him will be suspicious about other treatments approved by that specific organization (FDA), this would then lower vaccination rate. For this argument to hold we needed data to be as disaggregate as possible, so we chose county-level. Using local information is helpful because the effect we are studying is amplified by social proximity (as in Giulietti with MSOAs).

2. Data

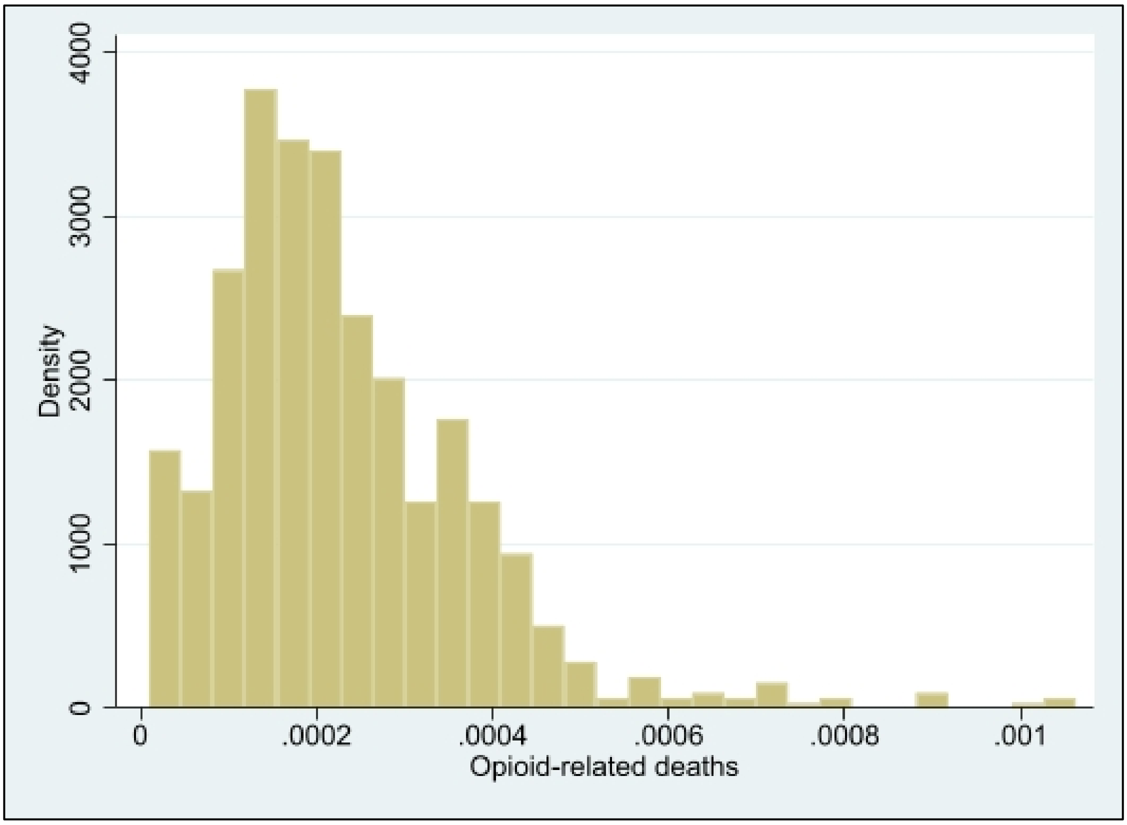
All the datasets are available online for research purpose. The main sources for data are Center for Disease Control and Prevention (CDC), United States' Bureau of Economic Analysis (BEA), Statista and Kaggle.

Vaccination rate is defined as the cumulative sum of people, aged at least 18, with two doses or more (also includes J&J) over total population. We chose to delete people under 18 because of heterogeneity in state regulations and to avoid the problem that could be caused by unvaccinated parents that decide not to vaccinate their children despite of their free will. All the data regarding vaccination rate are up to 01/2022.



Our main focus is on measuring trust in the government. In literature there are several different approaches to this topic. In (Glaeser, et al. 2000) trust is measured through a monetary experiment and a survey. The authors found that trust is both an individual and group characteristic, and that a component of trusting behavior may be stable over time. We focused on measuring trust in the government healthcare system, but in order to isolate the measurement from other components of overall confidence, we decided to include control variables shown to be correlated with general trust: education and abstention rate.

The variable of interest is deaths related to opioid drugs abuse, data taken from CDC Wonder, an online database which uses a rich ad-hoc query system for the analysis of public health data. [1]

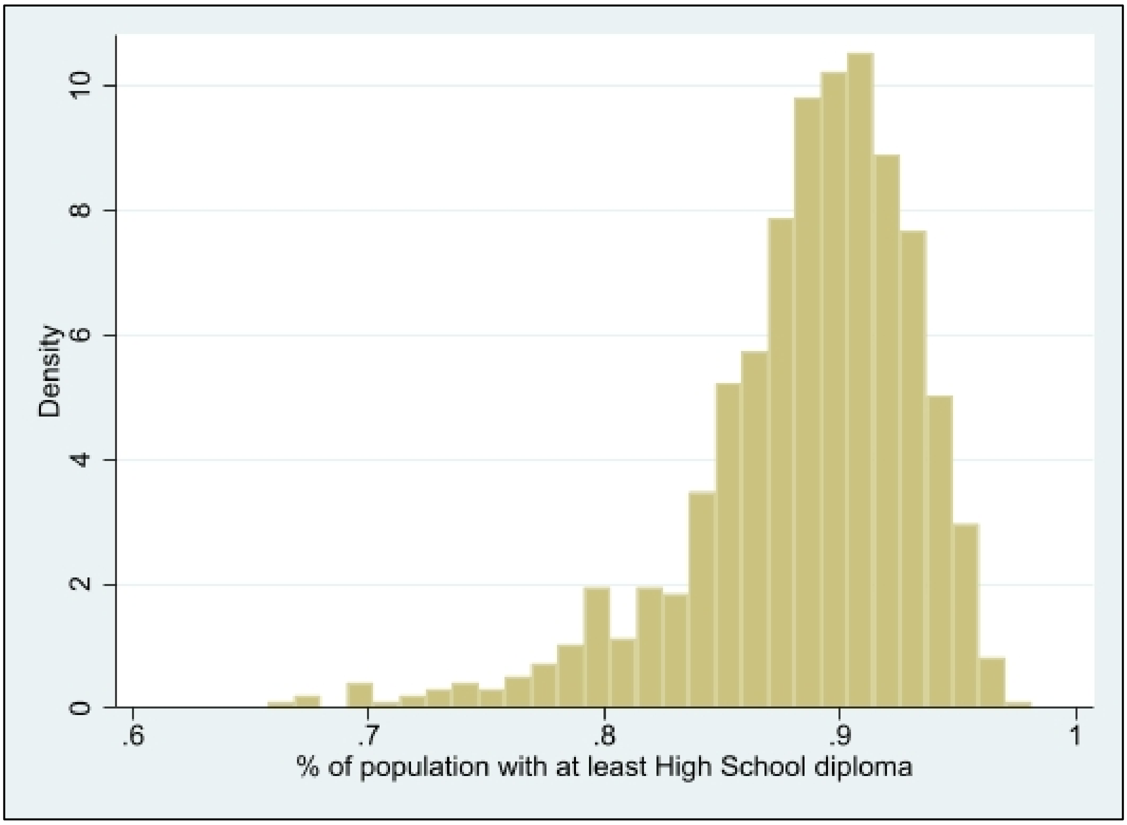


Counties are uniquely identified with a number, FIPS codes (Federal Information Processing Standard), where the first two digits represent the State, the 3 latter digits represent the county code. Our analysis is based on 875 counties (out of 3007), but they account for 273,692,294 people (82.68% of the total population). The main reason why we did not take into account all the counties is because data on some variables (for example overdoses) is not released by public authorities if the numbers are small; this could lead to legal issues regarding the identification of (otherwise) anonymous people.

Educational level is measured as a percentage of the total population with at least a high school diploma. Trying to measure education is always a difficult task, in this research we based our variable on a secondary result brought by National Opinion Research Center in a survey: General Social Survey (GSS). The main purpose of this survey was to estimate trust as a social capital component. Choosing high school diploma over other measures is notable since people

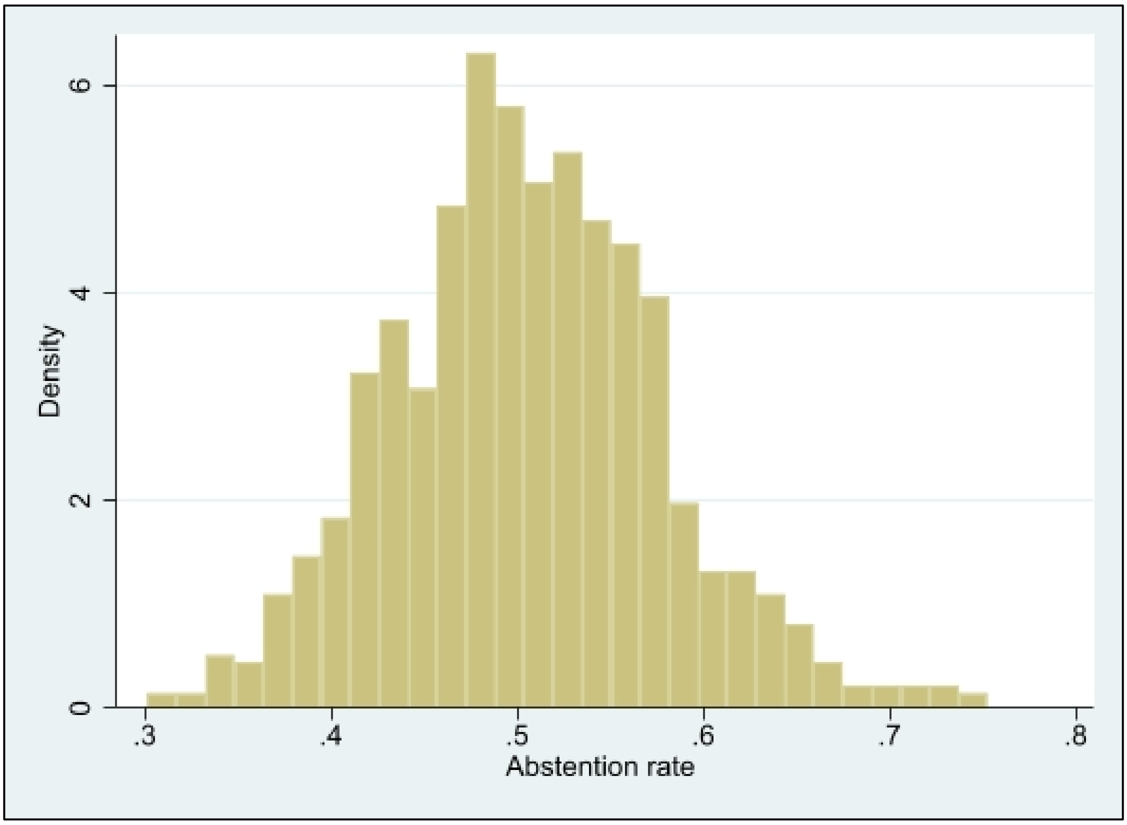
[1] The variable is defined as the sum of both Intentional and Unintentional Overdose related to the abuse of opioid drugs, over total population. All the overdoses (resulting in deaths) reported are both directly caused by opioid drugs abuse or indirectly caused by those drugs, for example a person who dies for both legal and illegal opioids abuse. The dataset contains all the major causes of deaths in U.S., based on death certificates for U.S. residents.

with at least a high school diploma gave an affirmative response in 45% of cases, compared to 26.3% of people without high-school diploma, thus showing that they are generally more trustworthy.

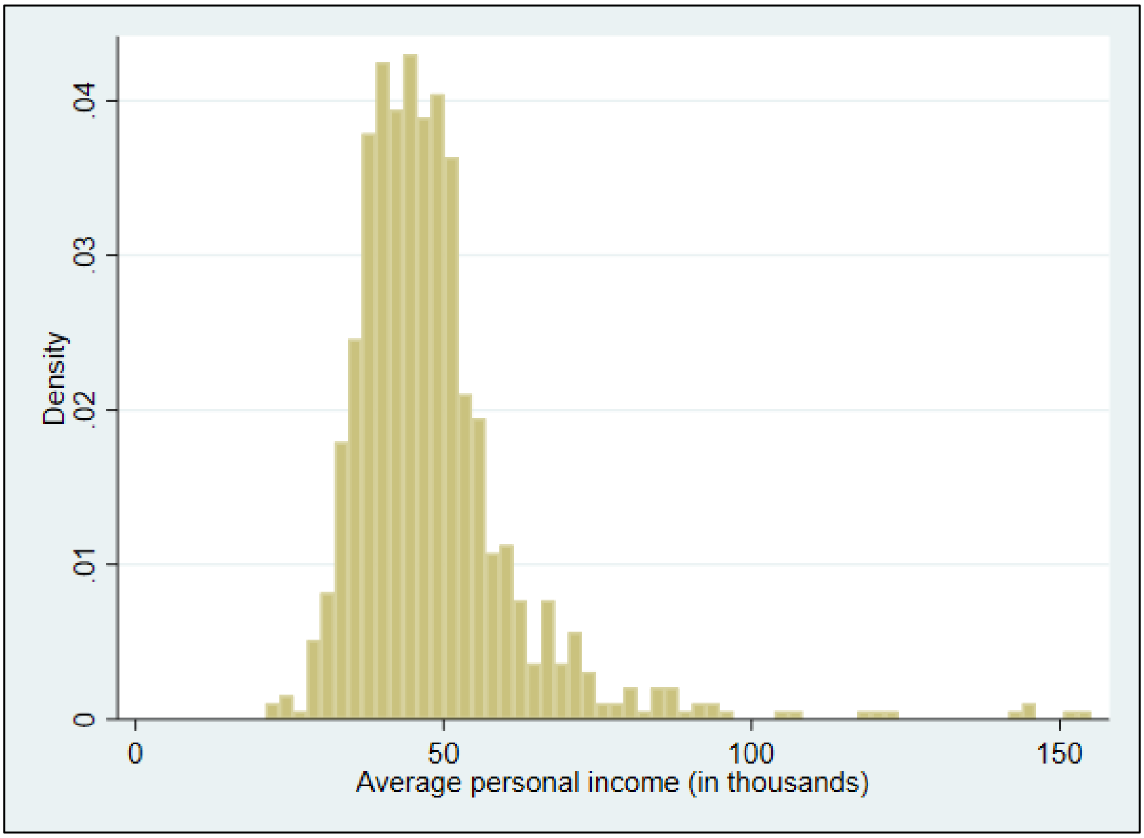


Another variable of interest is abstention rate, defined as the number of people who did not to vote during 2020 Presidential Election. This variable is particularly interesting because, in some sense, represents mistrust in government action. Liberal democracies are functioning properly when everyone is confident that his participation in the democratic process will have a positive outcome on his life. The abstention rate thus represents people's lack of confidence in government, and more broadly in institutions.[2]

[2] Information about this variable comes from MIT Election Data Science Lab in which there are data on county-level returns for presidential elections from 2000 up until 2020.



Our set of control variables includes: income, demographic characteristics and covid-related deaths. Income is defined as average personal earnings that people get from wages, dividends, interests, rents and government benefits by county. Demographic characteristics include both gender distribution and ethnic distribution. We chose to adopt women over total population as a gender distribution measure. We described ethnic characteristics by adding Afro-Americans and Hispanic divided by total population, since these two subgroups are the most prominent among United States' population; thus, we highlighted the presence of minorities in certain counties, as in Giulietti et al.



	Mean	SD	5%	10%	50%	90%	95%
Income	48.22	14.37	33.23	35.61	45.75	62	71.38
Population	312.79	579.45	38.9	48.5	148.4	727.2	1047.2
Sex distr.[3]	0.507	0.013	0.49	0.49	0.5	0.52	0.522
Minorities[4]	0.21	0.17	0.27	0.38	0.16	0.46	0.563

Another control variable is Covid-19 related deaths. Information about this variable comes from CDC Wonder, the procedure is the same as for overdoses. Covid-related deaths are defined as the number of people dying from the illness since the start of the pandemic until the vaccination campaign took place. We decided to add this constraint (as in Giulietti et al. 2021) to highlight the effect of deaths prior to the vaccine take-up. As shown in Giulietti et al., covid-related deaths have a positive effect on vaccination rate especially where minority groups are denser. This evidence is intuitive, since minorities tend to aggregate geographically the effect a covid-related death has on these groups is stronger.

These control variables help us trying to reduce Omitted Variable Bias because they may be correlated with the variables of interest and also may have a direct effect on vaccination rate.

[3] Sex Distribution is defined as female population over total.
[4] Minorities is defined as the sum of Afro-Americans and Hispanic over total population.
[Population and Income are in thousands]

3. Model

We estimate a simple linear model relating the vaccination rate to measures of trust:

$$vaccrate = \beta_0 + \beta_1 X + \beta_2 W + \varepsilon \quad \text{(I)}$$

Where: X = Variables of interest measuring trust; W = Control Variables

As shown in Table 1, opioid-related deaths and abstention rate have a strong negative coefficient, whereas education has a positive effect. Those variables highlight in different ways how trust affects vaccination rate. The first measure (ovd) is effective in predicting vaccination rates across countries. Education has an effect on trust in vaccines because of scientific knowledge (mandatory across schools) and the belief in institutions, whereas abstention rate is an *ex-post* measure, highlighting lack of trust mainly in political-driven institutions. Although we are far from explaining the effect that trust has on vaccination rates, these initial regressions capture some important information about the relationship that our variables under analysis have with vaccination rates. We clustered the standard errors at the state level to allow for arbitrary correlation in the errors across counties within the same state.

In order to reduce omitted variable bias, we added another set of controls including: income, sex composition, covid-related deaths, population size and minorities. Each one of these controls is relevant to our purposes, but we decided to split our set of controls into two groups: demographics (4) and trust-related controls (5).

Table 2 (6) is the baseline model. Model (6) estimates a -0.01037 variation in vaccination rate as a result of a Standard Deviation increase in opioid-related deaths. Our model estimates for a United States' Standard Deviation increase, 0.0005 covid-related deaths over population variation, a 0.00551 points variation in vaccination rate, whereas Giulietti et al. estimated a 0.00248 points variation in United Kingdom (as a result of the same standard deviation increase).

Despite the controls there may still be reason to be concerned with endogeneity, opioid-related deaths may still be correlated with unobserved factors not included in (6).

We focused on understanding in which direction our estimates might be biased, i.e., in which direction the explanatory variable is correlated with the error term. We thought that there may be unobservable factors, such as propensity to use pharmaceuticals, that may influence both vaccination rates and the number of people being treated with opioids, and thus the number of deaths related. We have therefore conjectured that may exist a positive correlation between opioid-related deaths and the error term.

In order to solve the endogeneity problem, we decided to use instrumental variable regression. Unemployment rate may be a valid instrument. The reasoning laying behind is: unemployed people are more likely to be depressed, and it is more probable they are going to use opioid drugs. There is evidence of an association between unemployment and rising depression symptoms: "Analysis of Epidemiologic Catchment Area panel data revealed that of employed respondents not diagnosed with major depression at first interview, those who became unemployed had over twice the risk of increased depressive symptoms and of becoming clinically depressed as those who continued employed" (Dooley et al. 1994). Depressed people are slightly more likely to initiate opioid treatment than non-depressed, whereas the first group is twice more likely to adopt opioids as a long-term treatment (as shown in Sullivan, 2018).

$$X_i = \pi_0 + \pi_1 Z_i + v_i \tag{II}$$

$$Y_i = \beta_0 + \beta_1 \hat{X}_i + \beta_1 \hat{v}_i + u_i \tag{III}$$

In order to lend unbiased estimates our instrumental variable must be both exogenous and relevant. The first assumption implies that the instrument is relevant for our purposes; the second one means that the dependent variable is uncorrelated with the instrument, which implies that the expected value of the error term conditional to the instrumental variable is zero.

The main reason why we included an instrument is explained by Angrist and Pischke (2009): "Intuitively, conditional on covariates, Two-Stage Least Square retains only the variation in Y that is generated by quasi-experimental variation, i.e., generated by the instrument, Z". Two-Stage Least Squares help us estimate unbiasedly the effect that opioid-related deaths have on vaccination rate. Table 3 (7) includes First Stage of the regression and all the controls, while (8) reports the estimates for 2SLS.

4. Results

We started by examining vaccination rate's determinants. Then we added variables to control for demographic and socio-economic factors. The final model (6) established a strong negative coefficient for opioid-related deaths. There could still exist correlation between the main variable of interest and the error term adding a positive bias to our model, due to some unobservable factor shifting estimates upwards. Through Instrumental Variable regression we were able to exclude this bias and to lend unbiased estimates.

The relationship between trust and opioid-related deaths cannot be rejected (for $p < 1\%$). Our final model estimates a -0.0647 points variation in vaccination rate as a consequence of one Standard Deviation increase in opioid-related deaths (0.00015). Such result can answer the main question laying behind our research, the relationship between the choice to vaccinate and trust in healthcare institutions.

5. Appendix

5.1 Tables

Table 1:

VARIABLES	(1) vrate	(2) vrate	(3)[5] vrate
ovd	-134.1**	-93.01	-141.0***
	(65.08)	*(76.08)*	*(43.85)*
educ		0.510*	0.480**
		(0.262)	*(0.207)*
abst_rate		-0.227**	-0.0715
		(0.0994)	*(0.0821)*
Observations	875	875	875
R-squared	0.026	0.118	0.564

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 2:

VARIABLES	(4) vrate	(5) vrate	(6) vrate
ovd	-138.1***	-147.0***	-70.60**
	(43.99)	*(38.90)*	*(34.53)*
pop		2.66e-05*	2.32e-05*
		(1.34e-05)	*(1.22e-05)*
income		8.11e-05	-5.27e-05
		(0.000191)	*(0.000163)*
f		1.068**	-0.00869
		(0.410)	*(0.554)*
min		0.118***	0.315***
		(0.0365)	*(0.0542)*
educ	0.592***		0.562***
	(0.211)		*(0.153)*
abst_rate	-0.0698		-0.500***
	(0.0829)		*(0.0977)*
covd	20.49*		10.89
	(11.01)		*(14.60)*
Observations	875	875	875
R-squared	0.568	0.591	0.674

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

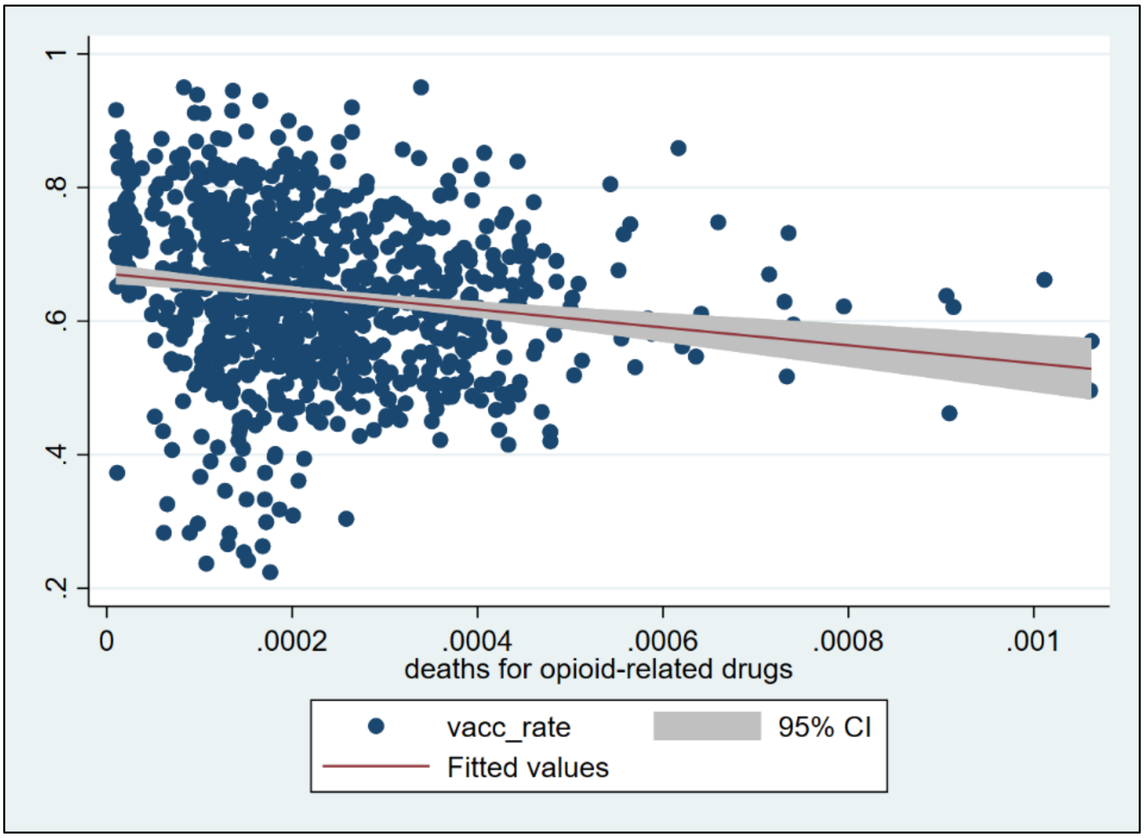
[5] From (3) onward state-dummies have been added;
[Population and income are in thousands]

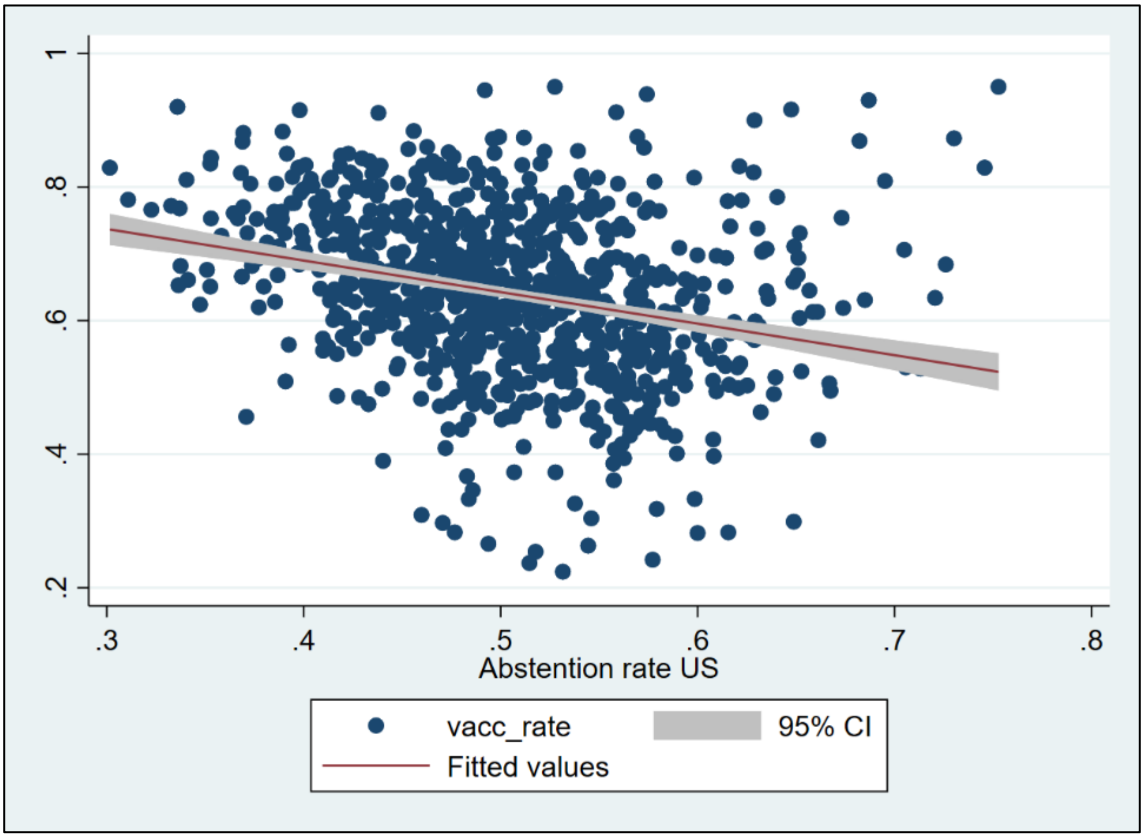
Table 3 (2SLS):

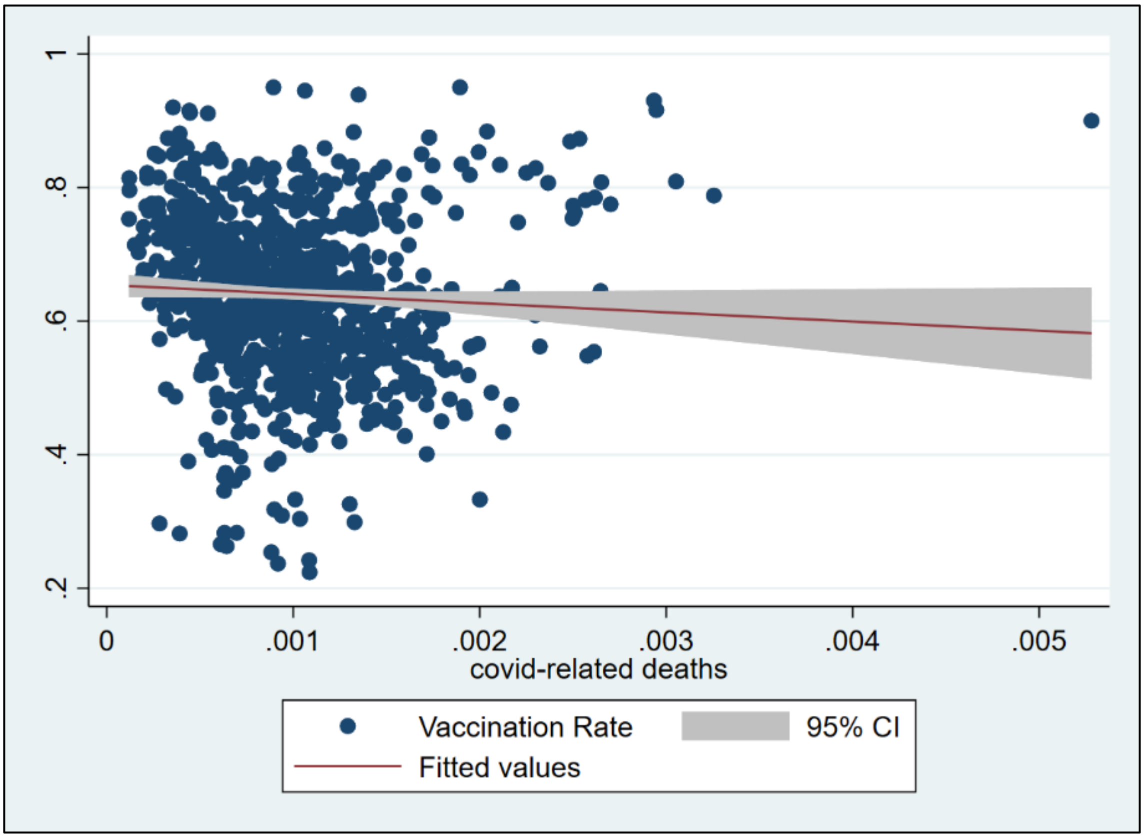
VARIABLES	(7) ovd	(8) vrate
ovd		-440.5***
		(170.3)
educ	-0.00066***	0.249
	(0.0002)	*(0.207)*
abst_rate	-0.00015	-0.488***
	(0.897e-04)	*(0.0962)*
covd	-0.0214	8.215
	(0.0172)	*(14.59)*
pop	-1.63e-08*	1.39e-05
	(8.78e-09)	*(1.05e-05)*
Income	-5.38e-08	-6.60e-05
	(2.01e-07)	*(0.000211)*
f	-0.000512	-0.0872
	(0.0003)	*(0.504)*
min	-0.00014**	0.272***
	(0.0003)	*(0.0450)*
un	0.002***	
	(0.0004)	
Observations	875	875
R-squared	0.562	0.562

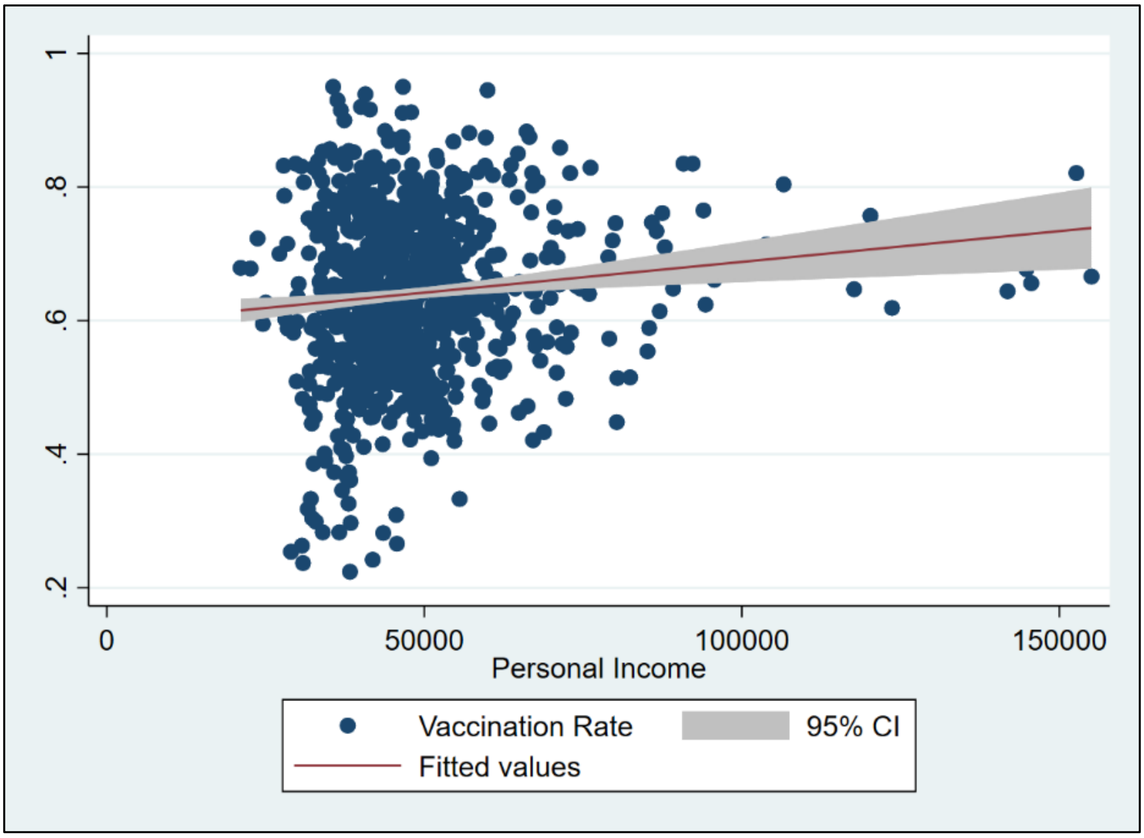
Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

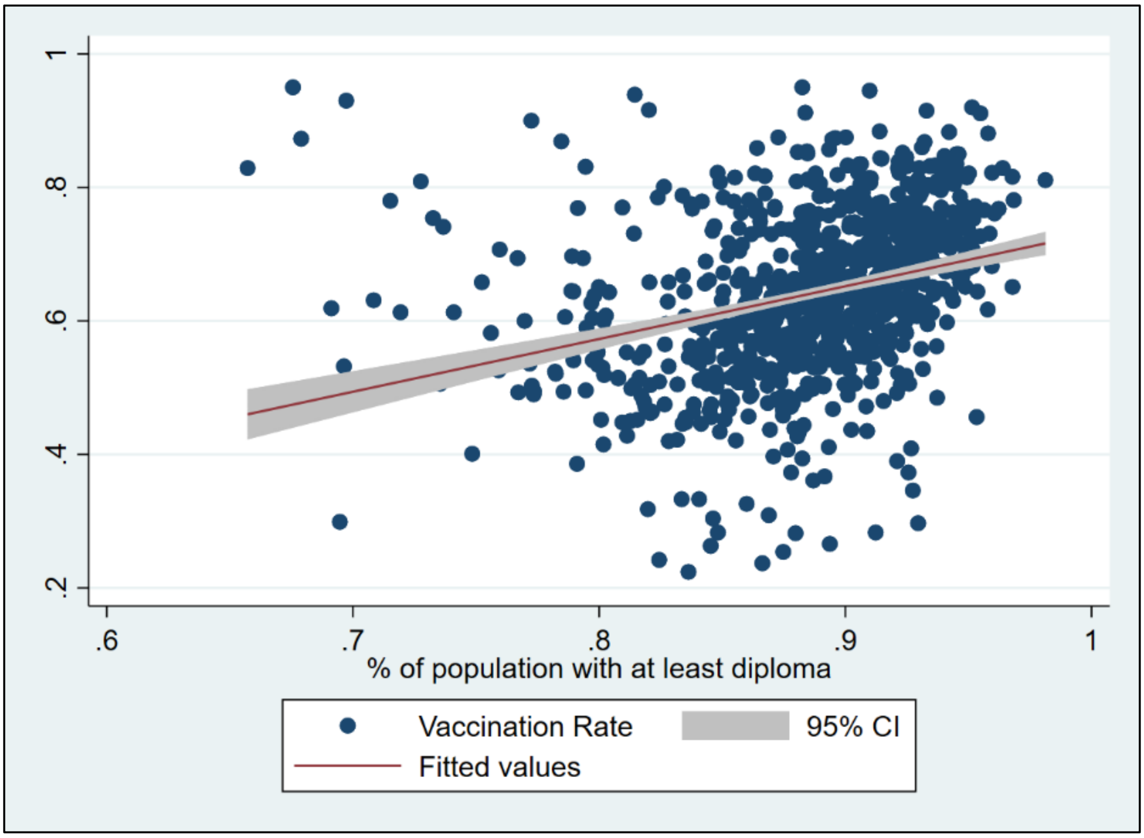
5.2 Additional Figures






.2
.4
.6
.8
1
0
.001
.002
.003
.004
.005
covid-related deaths
Vaccination Rate
95% CI
Fitted values


.2
.4
.6
.8
1
0
50000
100000
150000
Personal Income
Vaccination Rate
95% CI
Fitted values



1
.8
.6
.4
.2
.6
.7
.8
.9
1
% of population with at least diploma
Vaccination Rate
95% CI
Fitted values

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