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Can a supranational medicines agency restore trust after vaccine suspensions? The case of Vaxzevria

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Abstract

Over the first half of March 2021, the majority of European governments suspended Astrazeneca's Vaxzevria vaccine as a precaution following media reports of rare blood clots. We analyse the impact of the European Medicines Agency's (EMA) March 18th statement assuring the public of the safety of Vaxzevria and the immediate reinstatement of the vaccine by most countries on respondents' intention to get vaccinated. By relying on survey data collected in Luxembourg and neighbouring areas between early March and mid-April, we observe that the willingness to be vaccinated was severely declining in the days preceding the EMA statement. We implement a regression discontinuity design exploiting the time at which respondents completed the survey and find that the vaccine reinstatement substantially restored vaccination intentions.

Keywords: COVID-19, vaccine hesitancy, supranational regulation, public health, regression discontinuity design

JEL classification codes: I12, I18, C21, H12, H40

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1 Introduction

The COVID-19 pandemic is causing millions of deaths worldwide, despite attempts to control its spread via stringent lockdown policies. These events are having unprecedented impacts on the economy and on the well-being of all social layers of the world's population. Evidence shows that vaccination protects populations and drastically reduces the amount of hospital admissions (Rossman et al., 2021; Lopez Bernal et al., 2021; Vasileiou et al., 2021). Fully vaccinated people are protected against current variants of the virus, but the longer it takes to halt its circulation the larger the chances of additional mutations. However, the global distribution of vaccines faces production and logistical constraints that may slow down this process. An even bigger challenge to reaching herd immunity is hesitancy towards vaccination across the world (Williams et al., 2021). Vaccine hesitancy has been a growing threat to public health over recent years, notably due to a decline in the perceived danger posed by some diseases as well as to misinformation spread on social media (Horne et al., 2015; Luyten et al., 2019).

In the current pandemic, concerns about vaccine safety were fuelled by media reports in early March 2021 of rare cases of blood clots among people who received Astrazeneca's Vaxzevria vaccine. This led European governments to implement a large and uncoordinated wave of precautionary suspensions. By March 15th, 18 European countries had suspended Vaxzevria pending an official statement by the European Medicines Agency (EMA), the EU drug regulator.[1] While these suspensions sent an alarming signal to the European population, it is crucial to understand whether the EMA's intervention managed to restore trust and to safeguard the vaccination campaign.

In this paper, we assess the impact of the EMA's statement assuring the safety of Vaxzevria on individuals' willingness to be vaccinated. To address this question, we use data collected from an online survey on residents of Luxembourg and neighboring areas between early March and mid-April 2021. The data contains information on vaccination intentions as well as relevant socio-demographic characteristics and behavioural traits. We observe that the willingness to be vaccinated was severely declining in the days preceding the EMA' statement. This growing concern is in line with Google Trends data captured across the Greater Region (Luxembourg and its neighboring regions in France, Germany and Belgium). Figure 1 indeed shows an increase in searches for "blood clot" and "Astrazeneca" in the days preceding the EMA's statement. We use a regression discontinuity design (RDD) exploiting the time at which individuals responded to the survey, using the time of the EMA press conference about the vaccine's safety (March 18th at 17:00 CET) as cut-off. The RDD estimator shows that the EMA statement had an immediate and statistically significant impact on respondents' vaccination intentions. The effect we identify may be driven by a combination of the EMA's declaration and of the ensuing coordinated reinstatement of the vaccine by the EU member states, as both of these positive signals occurred within a few hours. Our results are robust to validation tests, i.e. placebo using different cut-offs, density tests and RDD tests on covariates.

[1] Vaxzevria was fully suspended by 13 European countries, and partially suspended by 5 others.

Figure 1: Google Trends searches for “Astrazeneca” and “blood clot” in the Greater Region of Luxembourg. The vertical dashed line indicates the day of the EMA statement.

Notes: Google Trends index for searches for ”Astrazeneca” and ”blood clot” in Luxembourg, Wallonia (Belgium), Saarland and Rhineland-Palatinate (Germany) and Lorraine (France) weighted by regional population size. Moving average over two days.

A large number of studies assess the effectiveness of public actions aimed at stimulating vaccine uptake. Singh et al. (2020) provide a meta analysis of 33 studies of the impact of diverse public actions to encourage vaccine acceptance. They conclude that community-based interventions (generally targeting parents or caregivers of children via home visits or information campaigns through community health workers, as well as reminder interventions), monetary incentives aimed at alleviating financial constraints (Banerjee et al., 2010), and technology-based health literacy have significant effects. Emotions play a strong role in vaccine hesitancy as well as in the methods to address it (Chou and Budenz, 2020).

While most papers analyze interventions targeting specific populations via interpersonal interactions, less is known about the effectiveness of large scale official communications about vaccine safety. Our paper contributes to this literature by studying the impact of an official regulator’s communication in a period of confidence crisis. The central message of the EMA statement, issued in an extraordinary meeting on March 18th, was that “the vaccine’s proven efficacy in preventing hospitalization and death from COVID-19 outweighs the extremely small likelihood of developing” such clots. Even though it did not scientifically rule out a link between the vaccine and the clot cases, the EMA statement was instantly followed by the reinstatement of Vaxzevria by 15 European countries, including France, Germany, Italy, Spain, and Luxembourg.

In the remainder of this paper we first present the survey and descriptive statistics of our sample, followed by OLS estimations on the individual determinants of the willingness to be vaccinated. We then present the RDD estimates on the effect of the EMA statement, and conclude.

2 Data

2.1 Survey structure

Our data come from an online survey conducted among the residents of Luxembourg and the border regions. The survey was organized by the Data Centre of the Luxembourg Institute of Socio-Economic Research (LISER) in collaboration with the University of Luxembourg, programmed in Qualtrics and advertised at the beginning of March in national online newspapers, on social media and on some local council websites with the title 'Socio-Economic Impact of COVID-19'.

After a general section in which information about employment status and demographic characteristics was collected, respondents were redirected to one of four randomly assigned blocks of questions covering various themes. Our block of interest concerns attitudes towards COVID-19 measures (social distancing, testing and vaccination) as well as behavioural patterns associated with compliance with these measures.

2.2 Sample and descriptive statistics

A total of 2,549 individuals completed the survey between the beginning of March and mid-April. Among them, 673 individuals were randomly allocated to the relevant block and provided an answer to the questions used in this analysis, specifically about their willingness to be vaccinated, and a set of questions regarding relevant sociodemographic characteristics as well as determinants of vaccination intentions. The information about the willingness to be vaccinated was collected via the following question: Do you intend to get vaccinated against COVID-19? Yes, absolutely (1) – Probably yes (2) – Probably not (3) – No (4). From this question we created a dummy variable which takes a value of 1 if respondents answered (1) or (2), and a value of 0 otherwise.[2] Table 1 shows the summary statistics of the survey respondents.

Our sample over-represents women (67%) with respect to the general population, while being generally in line with respect to the share of adults employed and with some tertiary education (55%).[3] Luxembourg is characterized by a particularly large share of foreign born among its resident population. This explains why 41% of the sample is composed of individuals who do not have the Luxembourg nationality. About three quarters of the sample are active on the labor market, and 37% of respondents' have a household income strictly above the median interval (€6,000 - €8,000).[4] Of the respondents, 44% are over the age of 50 and 68% consider that COVID-19 is dangerous for people in their age group, and this increases with age. Almost two thirds of the sample watch television at least once per day to get informed about the news. Finally, 64% of respondents have a strong confidence in the Luxembourgish government's action, whereas

[2]We choose this approach to highlight the variation among hesitant individuals, who could move from 'probably not' (3) to 'probably yes' (2) or 'yes' (1) after the vaccine's reinstatement. We discuss the robustness of our results to alternative aggregations of the dependent variable in the final section.

[3]At the national level, 52% of adult residents possess some tertiary education. Source: OECD (2019).

[4]Household income was captured through 7 intervals: €0-€1,250 ; €1,250-€2,000 ; €2,000-€4,000 ; €4,000-€6,000 ; €6,000-€8,000 ; €8,000-€12,500 ; >€12,500. The median interval, €6,000-€8,000, represents 24% of the sample.

Table 1: Descriptive statistics of the surveyed sample

	Proportion	S.D.
Willingness to be vaccinated	0.83	(0.38)
Woman	0.67	(0.47)
Luxembourg national	0.59	(0.49)
Single	0.14	(0.35)
Graduate	0.55	(0.50)
Employed	0.78	(0.41)
Age ≥ 50	0.43	(0.50)
Considers COVID-19 to be dangerous	0.68	(0.47)
Household income above the median	0.37	(0.48)
Daily TV information	0.62	(0.49)
Limited or no trust in government	0.36	(0.48)
Limited or trust in science	0.48	(0.50)
N	673	

36% either have limited or no trust, or did not want to express an opinion. Following the same classification, 48% did not express strong confidence in the scientific community.[5]

2.3 Determinants of the willingness to be vaccinated

A vast literature analyses the determinants of the willingness to be vaccinated. Vaccine hesitancy is linked to low education and income (Paul et al., 2021), to minority ethnic groups (Razai et al., 2021), to the use of specific information channels (Goldstein et al., 2015; Chadwick et al., 2021) as well as to personality traits (Puri et al., 2020; Murphy et al., 2021, among other factors).

Before introducing our regression discontinuity estimates of the causal effect of the EMA's intervention, we present here some estimates of a linear probability model with incremental sets of covariates in line with previous research. The basic determinants we consider are gender, being a Luxembourg national, marital status, level of education, employment status, and age. We further control for income, for beliefs about the danger that COVID-19 represents given the respondent's age, and the daily use of traditional media channels (TV), as this information source is expected to mitigate vaccine hesitancy relative to other sources such as social media. Finally, we include variables about trust in the government's action and in the scientific community. Results are reported in Table 2.

Results from this preliminary regression are in line with previous research on the determinants of vaccination propensity. First, Table 2 shows that the willingness to be vaccinated does not significantly differ between women and men, or between single and married respondents. Luxembourg nationals appear to be more willing to be vaccinated in the most basic specifications

[5]This somewhat high proportion of individuals lacking trust in the scientific community should be put in perspective. Indeed, only 5% of the overall sample state that they do not trust the scientific community at all, whereas 52% have a high level of trust. The remainder (43%) is composed of individuals having limited trust or preferring not to express their opinion.

(columns (1) and (2)), but this coefficient loses significance once we take the respondents' level of trust in science and in government action into account (column (3)). Respondents who attained higher education are significantly more willing to be vaccinated than others in all specifications. We also find a weak positive effect among employed individuals and among respondents above 50 years of age, whereas having a household income above the median plays no role on vaccination intentions. Respondents who consider COVID-19 to be dangerous given their age have a significantly stronger intention to be vaccinated, by about 20 percentage points. The inclusion of this variable naturally mitigates the effect of age. Getting informed through television at least once per day is associated with a higher propensity to get vaccinated.[6] Finally, respondents who do not express a strong degree of trust in the government's action, and/or in the scientific community, are also less willing to be vaccinated.

3 RDD estimates of the impact of the EMA statement

3.1 Identification Strategy

As explained in the Introduction, on March 18th the EMA held a press conference to provide assurance about the safety of the Vaxvervria vaccine. We consider this statement –and the immediate reinstatement of the vaccine by 15 out of the 18 European governments that had suspended it– as our treatment. This treatment is thus to be interpreted as a strong multilateral signal from both medical and governmental institutions aimed at restoring trust in a period of turmoil. Our identification strategy is based on the comparison of the intentions to be vaccinated between individuals who responded shortly before and shortly after the announcement, on March 18th at 17:00 CET. This comparison is based on the assumption that the composition of both groups of respondents is similar at the cutoff.[7] We thus interpret any discontinuity in the willingness to be vaccinated at the threshold as the causal impact of the EMA statement and the immediate vaccine reinstatement by European governments. Our data allows us to implement such a strategy thanks to the availability of the exact time at which respondents started and completed the survey, and the fact that the sample contains observations from every day during the month of March and the first half of April.[8]

We therefore implement an RDD estimator using the time of response as the running variable. We follow the standard approach of the literature, running a local linear regression using the optimal mean squared error criterion for each side of the cutoff and triangular kernel weights (Calonico et al., 2014), which is estimated by the following linear model:

[6] Richer specifications involving other types of media, such as newspapers, radio and social media, were considered, but these covariates were insignificant.

[7] We confirm this in Table 5, which provides results of an RDD on the observable determinants of the willingness to be vaccinated; these are not significantly different at the cut-off.

[8] This is not the case for other publicly available datasets such as the Imperial College London YouGov Covid 19 Behaviour Tracker Data Hub (https://www.imperial.ac.uk/centre-for-health-policy/our-work/our-response-to-covid-19/covid-19-behaviour-tracker/).

Table 2: Determinants of the willingness to be vaccinated: linear regressions

	(1)	(2)	(3)
Woman	0.039	0.0133	0.015
	(1.26)	(0.46)	(0.53)
Luxembourg national	0.053*	0.045	0.042
	(1.76)	(1.58)	(1.55)
Single	0.040	0.052	0.052
	(0.96)	(1.32)	(1.35)
Graduate	0.127***	0.129***	0.089***
	(4.27)	(4.50)	(3.18)
Employed	0.060	0.074**	0.075**
	(1.63)	(2.14)	(2.26)
Age $\geq$ 50	0.123***	0.060**	0.066**
	(3.99)	(1.99)	(2.30)
Considers COVID-19 to be dangerous		0.244***	0.202***
		(8.28)	(7.04)
Household income above the median		0.036	0.022
		(1.23)	(0.80)
Daily TV information		0.108***	0.108***
		(3.73)	(3.89)
Lack of trust in government			-0.123***
			(-4.22)
Lack of trust in science			-0.134***
			(-4.77)
Constant	0.597***	0.387***	0.548***
	(11.24)	(7.06)	(9.73)
R^2	0.048	0.166	0.237
N	673	673	673

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

$$
\begin{aligned}
y_i &= \alpha + \delta \cdot \mathbb{1}(z_i \geq 17:00, 18/03/21) + \beta z_i \cdot \mathbb{1}(z_i < 17:00, 18/03/21) \\
&+ \gamma z_i \cdot \mathbb{1}(z_i \geq 17:00, 18/03/21) + \varepsilon_i,
\end{aligned} \tag{1}
$$

where

- y_i is the outcome variable, which is equal to 1 if respondent i intends to get vaccinated and zero otherwise;
- α is the constant term;
- z_i is the exact time at which respondent i finished the survey;
- $\mathbb{1}(\cdot)$ is the indicator function, which is equal to 1 if the argument is true. Therefore, $\mathbb{1}(z_i \geq 17:00, 18/03/21)$ is a dummy indicator equal to 1 if respondent i completed the survey after the EMA statement.
- δ is the causal effect of the EMA statement on the outcome;
- $\beta z_i \cdot \mathbb{1}(z_i < 17:00, 18/03/21)$ is the linear spline on the left of the cutoff.
- $\gamma z_i \cdot \mathbb{1}(z_i \geq 17:00, 18/03/21)$ is the linear spline on the right of the cutoff;
- ε_i is the idiosyncratic error term (with zero conditional mean).

We implement two extensions of this baseline model. First, we add a set of control variables X, which include the determinants used in Section 2.3 as well as the time of responses (morning, afternoon, evening/night) and the day of the week (weekday or weekend).[9] Second, we allow for a local quadratic spline.

In Subsection 3.2, we present the results from the four versions of the model. In Subsection 3.3, we introduce various validity tests developed in the literature and some sensitivity analyses using alternative definitions of the running and dependent variables.

[9]Time-of-response variables are aimed at controlling for changes in the composition of respondents over specific moments of the day and week.

3.2 Main results

In Table 3 and Figure 2, we report the RDD estimates of the effect of the EMA statement of the 18th of March. Column (1) shows the estimates from the local linear regression of equation (1) without covariates. Column (3) provides linear regression results controlling for the covariates used in the preliminary analysis and the time-of-response variables. Columns (2) and (4) follow the same logic (without and with covariates) but using a more flexible (local quadratic) spline. We find a substantial positive effect of the EMA statement on the intention to be vaccinated of almost 50 percentage points. This effect is statistically significant at the 1% level and robust in all four specifications. Considering the overall evolution of the outcome, the EMA statement was able to sharply invert the collapsing confidence and return it to the pre-crisis level.

Table 3: RDD estimates

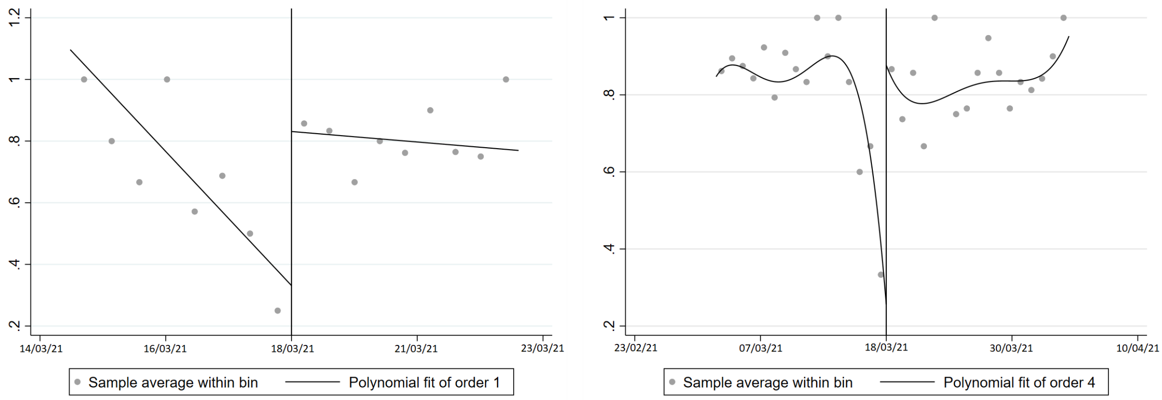
	(1)	(2)	(3)	(4)
Effect at cut-off	0.484***	0.518***	0.488***	0.476***
Robust p-value	0.007	0.004	0.001	0.008
Robust 95% CI	[0.143 ; 0.926]	[0.187 ; 0.969]	[0.213 ; 0.828]	[0.133 ; 0.879]
Y right	0.827	0.829	0.816	0.831
Y left	0.343	0.311	0.325	0.219
BW Loc. Poly. [h] - left	14/03/21 02:42	10/03/21 01:03	14/03/21 06:46	13/03/21 20:04
BW Loc. Poly. [h] - right	24/03/21 20:37	31/03/21 16:23	24/03/21 03:59	29/03/21 23:58
BW Bias [b] - left	10/03/21 20:53	07/03/21 22:28	11/03/21 09:42	11/03/21 20:03
BW Bias [b] - right	30/03/21 13:29	04/04/21 17:42	29/03/21 04:53	01/04/21 13:04
Order loc. poly. [p]	1	2	1	2
Order bias [q]	2	3	2	3
Covariates	No	No	Yes	Yes
N	696	696	673	673
Eff. N estimate [h]	132	328	128	239
Eff. N bias [b]	280	413	244	306

Notes: The dependent binary variable is equal to 1 if the individual responds that they are willing to be vaccinated. z is the running variable on the time of survey completion, with a cut-off on the 18th of March at 17:00. We follow Calonico et al. (2014) with the following options: triangular kernel; variance–covariance matrix estimated using the heteroskedasticity-robust nearest-neighbour variance estimator. Different models: (1) local linear polynomial regression based on the MSE-optimal bandwidth selector for each side of the cut-off, (2) local quadratic polynomial, (3) local linear polynomial regression adding covariates, (4) local quadratic polynomial adding covariates. The table shows the optimal bandwidth for each side of the cut-off for the estimate (h) and the bias (b). * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

In the following Subsection, we introduce validation tests and sensitivity analyses of these results.

Figure 2: The impact of the EMA statement on the willingness to get vaccinated.

(a) Local linear regression (b) Global-quartic polynomial



Notes: These graphs show RDD plots for the dependent binary variable equal to 1 if the individual is willing to get vaccinated, using the time of survey completion as the running variable with a cut-off at 17:00 on the 18th of March. Graph (a) is obtained using a local linear polynomial regression with triangular weights and bandwidth following the optimal mean squared error criterion in Calonico et al. (2014). Graph (b) is obtained using a global -quartic polynomial and uniform weights.

3.3 Tests and sensitivity analysis

We further our analysis by conducting several validation tests on the identifying assumptions of the estimator. First, we implement standard density tests proposed in the literature (Calonico et al. (2014)) to check for the existence of mass points on the number of respondents around the cutoff, which may be a sign of manipulation of the running variable z. Second, we test whether the observable composition of the respondents changes at the cutoff by obtaining RDD estimates for our set of covariates X. Finally, we implement placebo tests by testing the effect on false cutoff points of z such as the median value of z_i for the individuals on the left or on the right of the true cut-off (namely, March 6th, 2021, and March 27th, 2021). We discuss the results of these tests in this Subsection and report the corresponding tables in the Appendix.

First, we check whether the density of the respondents changes sharply at the discontinuity. This test aims to rule out manipulation by individuals with specific (unobservable) characteristics (e.g. anti-vaccine views) that might bias survey results before or after the cut-off. This is rather unlikely, however, as only a fourth of respondents were assigned to the vaccination module of the survey, and its content was not public. The density test of Cattaneo et al. (2020) confirms that this is not the case, with a robust bias-corrected p-value of 0.962. Second, we do not find evidence of any compositional differences in terms of X's at the cut-off point, which also attenuates possible concerns regarding the self-selection of respondents. This means that respondents neither differ in terms of observable characteristics at the time of the statement nor show a higher rate of response to the survey on either sides of the cut-off. Third, the placebo tests on false cut-off points do not show significant effects (see Table 4 in the Appendix).

Finally, we provide additional sensitivity analyses on the running and dependent variables.

First, we test the robustness of our results to the definition of our running variable z. Since the baseline running variable is the time of survey completion, a small number of respondents who completed the survey after March 18th at 17:00 CET might have answered the question about vaccination intentions *before* the EMA statement. We thus rerun the analysis using as an alternative running variable the time at which respondents *started* the survey. Table 6 in the Appendix shows that this definition of the running variable delivers even larger point estimates, though still within the confidence interval of our benchmark results.

Second, the dependent variable (the willingness to be vaccinated) was originally captured in the survey through 4 possible answers (Yes, absolutely (1); Probably yes (2); Probably not (3); No (4)). Our baseline results are based on a binary dependent variable aggregating the two positive answers as 1s and the two negative answers as 0s. We therefore check the sensitivity of our results to different versions of the dependent variable. An alternative aggregation consists in opposing the definite 'No' (4) to the other answers, (1) to (3). We show in Table 7 in the Appendix that the results are robust to this alternative formulation of the dependent variable, suggesting that the reinstatement led some individuals who definitely did not want to be vaccinated during the suspension period to reconsider their refusal. In contrast, opposing the 'Yes, absolutely' (1) to all other possible responses does not yield conclusive results (see Table 8). This is sensible since it is less likely that individuals who were already mildly in favour of vaccination would become absolutely convinced by the reinstatement, whereas this definition of the variable annihilates variation among the hesitant individuals.

To conclude, our validation and robustness tests confirm the reliability of our estimates in representing the causal effect of the EMA statement of the 18th of March.

4 Discussion

The global vaccination campaign against COVID-19 is one of the most crucial challenges in recent history, and vaccine hesitancy is arguably the most important factor threatening its success. The vaccination rates in the most proactive countries such as Israel and the US are indeed struggling to reach sufficient levels for the acquisition of herd immunity (respectively 65% and 55% on the 6th of July 2021- see Figure 4 in the Appendix). Various attempts are being made to convince anti-vax and vaccine-hesitant individuals to reconsider their position through 'carrot and stick' policies.[10] The emergence of more aggressive variants makes the battle against vaccine hesitancy all the more pressing.

Most of the research on public policies aiming to address vaccine hesitancy has focused on targeted interventions (community-based interpersonal interactions and incentives (Singh et al., 2020)). Recently in Europe, public actions fuelled hesitancy when 18 European governments

[10] https://www.theguardian.com/us-news/2021/may/27/california-covid-19-vaccine-lottery; https://www.ft.com/content/18791bdf-ad1a-4f5e-b99a-28aee18fe9f7; https://www.timesofisrael.com/israel-risks-losing-teenagers-to-anti-vaxxer-influence-warns-top-doctor/; https://www.reuters.com/world/europe/romanians-queue-covid-19-vaccine-free-barbecue-bustling-market-2021-06-11; https://today.rtl.lu/news/science-and-environment/a/1717247.html

suspended Vaxvevria without coordination following news reports of rare blood clots. Our data confirm that in the days that followed these events, intentions to get vaccinated severely declined.

In this paper, we study whether the communication of a supranational drug regulator, the EMA, and the coordinated vaccine reinstatement by 15 governments could restore intentions to get vaccinated to previous levels, despite the confidence crisis. While the intention to get vaccinated was at its lowest in the days preceding the EMA statement, we find that the vaccine's reinstatement led to an increase in the intention to get vaccinated of about 50 percentage points. Our findings are robust to multiple tests.

Interestingly, our finding that the endorsement of the official regulator followed by a coordinated action allowed to rebuild confidence had been hypothesized by Larson and Broniatowski (2021). Considering the level of advancement of the vaccination phase, in which significant efforts and investments have been made, this result is particularly important. Moreover, this result has wider implications as the lack of coordination observed at the European level is susceptible to occurring at more local levels of governance. As recently observed in Italy, local governments in different regions indeed tend to adopt heterogeneous strategies depending, for instance, on their local level of exposure to rare cases of side effects.[11] Our results establish that maintaining a common vision and centralized approach is essential to reaching herd immunity at a global level.

Regarding the determinants of vaccination intent, our results are in line with previous evidence. In particular, we find that the willingness to get vaccinated is lower among people with a lower educational attainment, among individuals below the age of 50, and among individuals who do not perceive COVID-19 to be dangerous.[12] Lack of trust in science and in government action also correlate negatively with the willingness to get vaccinated, whereas frequent traditional media consumption (TV) is positively correlated with vaccination intent.

Finally, we acknowledge that a reported intention to get vaccinated may differ from individuals' actual behaviour. In the presence of a social desirability bias, one might indeed expect that some individuals state that they intend to be vaccinated but do not go through with it. In a recent survey, Abdallah and Lee (2021) find that US college students consider themselves more responsible than their peers, believing that other students are less likely to get vaccinated. Still, our results capture a clear break between the pre- and post-EMA declaration periods. In particular, the spectacular drop in the propensity to vaccinate observed in the days preceding the EMA statement could only be triggered by a change in the perceived safety of the vaccines, as observed in Google Trends. The vaccine's reinstatement seems to have flattened this wave of panic.

[11] see https://www.nytimes.com/2021/06/11/world/italy-astrazeneca-covid-vaccine.html

[12] Fisher et al. (2020) obtain similar findings from a representative sample in the US.

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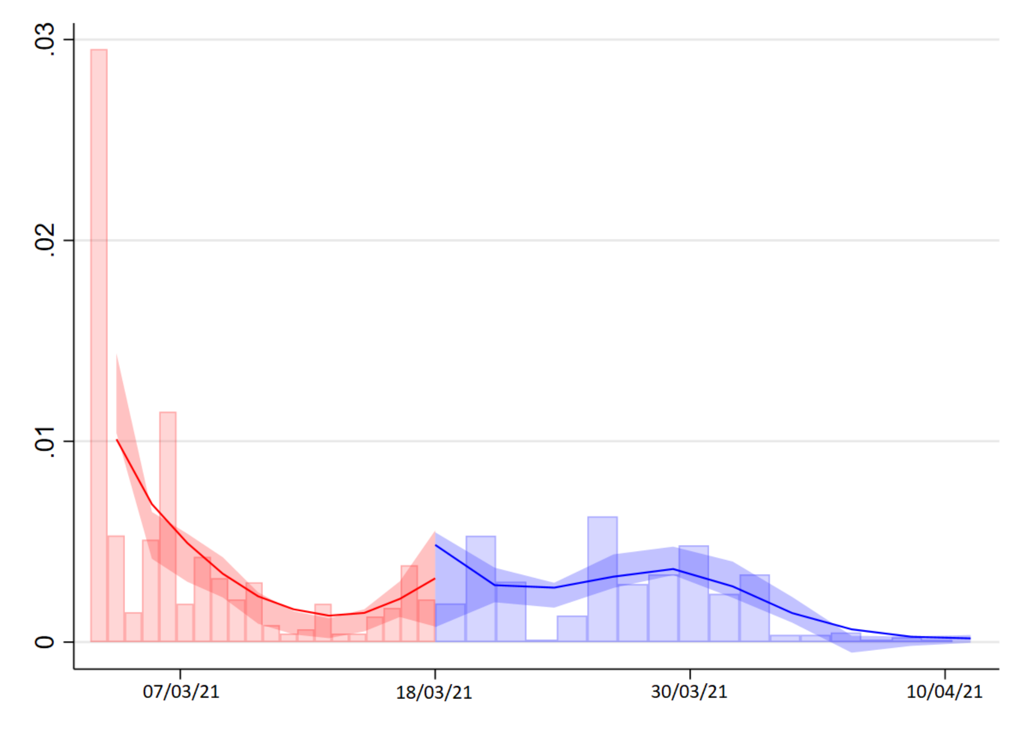
5 Appendix

Figure 3: Density of survey responses over time.



Notes: Manipulation test using the local polynomial density estimators proposed in Cattaneo et al. (2020) and Cattaneo et al. (2021). Stata command rddensity. A local quadratic approximation with kernel triangular weights is used to construct the density estimators, while a cubic approximation is used for the bias-corrected density estimator. The density estimation method is unrestricted (two-sample). Robust bias-corrected statistic with jackknife standard errors and uniform confidence interval at 95% level (2000 of simulations).

Table 4: Placebo tests

	(1)	(2)
Effect at cut-off	-0.085	-0.078
Robust *p*-value	0.437	0.222
Robust 95% CI	[-0.311 ; 0.134]	[-0.315 ; 0.073]
Y right	0.830	0.895
Y left	0.915	0.972
BW loc. poly. [h] - left	05/03/21 00:25	25/03/21 07:45
BW loc. poly. [h] - right	09/03/21 08:59	01/04/21 10:02
BW bias [b] - left	04/03/21 10:22	23/03/21 01:02
BW bias [b] - right	12/03/21 06:17	06/04/21 10:55
Order loc. poly. [p]	1	1
Order bias [q]	2	2
Covariates	No	No
N	381	315
Eff. N estimate [h]	122	174
Eff. N bias [b]	168	210

Notes: The dependent binary variable is equal to 1 if the individual answers that they are willing to get vaccinated. Placebo tests: z is the running variable on the time of survey completion, with a cut-off on the 6th (1) or the 27th (2) of March. We follow Calonico et al. (2014) with the following options: triangular kernel; variance–covariance matrix estimated using the heteroskedasticity-robust nearest-neighbour variance estimator and local linear polynomial regression based on the MSE-optimal bandwidth selector for each side of the cut-off. The table shows the optimal bandwidth for each side of the cut-off for the estimate (h) and the bias (b). * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Table 5: Effect on covariates

VARIABLES	(1) Woman	(2) Single	(3) Age≥50	(4) COVID dangerous	(5) Lux. nationality	(6) Graduate	(7) Employed	(8) High income	(9) Daily TV	(10) Low trust in gov.	(11) Low trust in science
Effect at cut-off	0.230	-0.056	-0.019	0.140	0.212	0.166	-0.115	0.147	0.022	0.028	-0.131
Robust *p*-value	0.148	0.576	0.860	0.320	0.232	0.289	0.307	0.392	0.797	0.995	0.373
Robust 95% CI	[-0.09;0.60]	[-0.37;0.20]	[-0.44;0.37]	[-0.13;0.40]	[-0.10;0.41]	[-0.18;0.62]	[-0.36;0.11]	[-0.18;0.47]	[-0.51;0.39]	[-0.39;0.39]	[-0.41;0.16]
Y right	0.684	0.175	0.268	0.566	0.691	0.509	0.785	0.473	0.557	0.604	0.513
Y left	0.454	0.232	0.288	0.426	0.479	0.343	0.900	0.326	0.535	0.576	0.644
BW loc. poly. [h] - left	12/03/21 04:45	11/03/21 02:06	12/03/21 00:31	12/03/21 15:51	15/03/21 05:38	15/03/21 06:22	11/03/21 10:13	12/03/21 11:38	14/03/21 14:51	14/03/21 03:36	10/03/21 20:10
BW loc. poly. [h] - right	27/03/21 04:48	26/03/21 19:09	23/03/21 14:39	27/03/21 12:20	27/03/21 21:19	27/03/21 04:35	26/03/21 06:53	28/03/21 12:43	27/03/21 09:56	24/03/21 04:38	27/03/21 06:35
BW bias [b] - left	09/03/21 04:22	07/03/21 15:07	09/03/21 06:07	09/03/21 12:31	12/03/21 16:22	12/03/21 01:17	07/03/21 21:25	09/03/21 21:59	12/03/21 00:29	10/03/21 19:48	08/03/21 00:40
BW bias [b] - right	02/04/21 14:13	01/04/21 19:39	29/03/21 02:58	03/04/21 02:34	03/04/21 16:39	02/04/21 15:56	31/03/21 11:28	05/04/21 19:38	03/04/21 03:20	29/03/21 13:22	02/04/21 11:45
Order loc. poly. [p]	1	1	1	1	1	1	1	1	1	1	1
Order bias [q]	2	2	2	2	2	2	2	2	2	2	2
Covariates	No	No	No	No	No	No	No	No	No	No	No
N	696	696	690	690	696	696	696	695	691	695	692
Eff. N estimate [h]	208	200	142	213	211	194	181	234	198	132	214
Eff. N bias [b]	374	402	276	375	348	345	365	375	347	264	397

Notes: RDD estimates on the covariates as defined in Section 2. z is the running variable on the time of survey completion with a cutoff on the 18th of March. We followed Calonico et al. (2014) with the following options: triangular kernel; variance-covariance matrix estimated using the heteroskedasticity-robust nearest-neighbour variance estimator and local linear polynomial regression based on the MSE-optimal bandwidth selector for each side of the cutoff. The table shows the optimal bandwidth for each side of the cutoff for the estimate (h) and the bias (b). * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table 6: RDD estimates using time at the beginning of the survey as running variable

	(1)	(2)	(3)	(4)
Effect at cut-off	0.603***	0.644***	0.610***	0.613***
Robust *p*-value	0.001	0.001	0.000	0.000
Robust 95% CI	[0.275 ; 1.050]	[0.293 ; 1.101]	[0.322 ; 0.936]	[0.302 ; 1.032]
Y right	0.872	0.862	0.862	0.869
Y left	0.269	0.218	0.232	0.111
BW loc. poly. [h] - left	14/03/21 13:30	11/03/21 14:46	15/03/21 02:11	14/03/21 07:41
BW loc. poly. [h] - right	23/03/21 23:58	31/03/21 13:39	23/03/21 19:45	30/03/21 03:47
BW bias [b] - left	11/03/21 11:49	09/03/21 19:31	13/03/21 06:16	12/03/21 13:18
BW bias [b] - right	29/03/21 12:45	04/04/21 03:06	28/03/21 23:26	31/03/21 14:05
Order loc. poly. [p]	1	2	1	2
Order bias [q]	2	3	2	3
Covariates	No	No	Yes	Yes
N	696	696	673	673
Eff. N estimate [h]	124	291	119	235
Eff. N bias [b]	244	355	222	277

Notes: The dependent binary variable is equal to 1 if the individual answers that they are willing to get vaccinated. z is the running variable on the starting time of the survey, with a cut-off at 17:00 on the 18th of March. We follow Calonico et al. (2014) with the following options: triangular kernel; variance–covariance matrix estimated using the heteroskedasticity-robust nearest-neighbour variance estimator. Different models: (1) local linear polynomial regression based on the MSE-optimal bandwidth selector for each side of the cut-off, (2) local quadratic polynomial, (3) local linear polynomial regression adding covariates, (4) local quadratic polynomial adding covariates. The table shows the optimal bandwidth for each side of the cut-off for the estimate (h) and the bias (b). * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Table 7: RDD estimates with a different outcome definition: Y=1 if ‘Yes, absolutely’, ‘Probably yes’, or ‘Probably no’, Y=0 if ‘Definitely no’

	(1)	(2)	(3)	(4)
Effect at cut-off	0.432***	0.577***	0.368***	0.453***
Robust p-value	0.005	0.002	0.001	0.003
Robust 95% CI	[0.148 ; 0.833]	[0.247 ; 1.050]	[0.160 ; 0.669]	[0.174 ; 0.870]
Y right	0.957	0.968	0.953	0.882
Y left	0.525	0.391	0.575	0.322
BW loc. poly. [h] - left	14/03/21 23:31	13/03/21 09:35	13/03/21 15:55	14/03/21 03:41
BW loc. poly. [h] - right	24/03/21 08:58	29/03/21 13:51	25/03/21 02:46	01/04/21 19:00
BW bias [b] - left	11/03/21 23:30	10/03/21 23:57	09/03/21 16:23	11/03/21 22:31
BW bias [b] - right	30/03/21 16:06	02/04/21 17:41	30/03/21 23:25	07/04/21 06:02
Order loc. poly. [p]	1	2	1	2
Order bias [q]	2	3	2	3
Covariates	No	No	Yes	Yes
N	696	696	673	673
Eff. N estimate [h]	130	252	129	303
Eff. N bias [b]	279	351	303	341

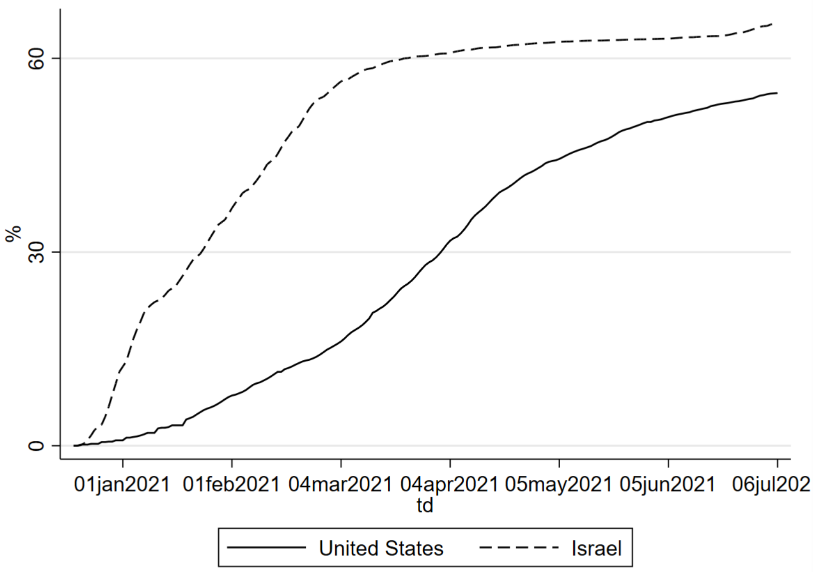
Notes: The dependent binary variable is equal to 1 if the individual answers that they may get vaccinated (‘Yes, absolutely’, ‘Probably yes’, or ‘Probably no’) and 0 otherwise. z is the running variable on the ending time of the survey, with a cut-off at 17:00 on the 18th of March. We follow Calonico et al. (2014) with the following options: triangular kernel; variance–covariance matrix estimated using the heteroskedasticity-robust nearest-neighbour variance estimator. Different models: (1) local linear polynomial regression based on the MSE-optimal bandwidth selector for each side of the cut-off, (2) local quadratic polynomial, (3) local linear polynomial regression adding covariates, (4) local quadratic polynomial adding covariates. The table shows the optimal bandwidth for each side of the cut-off for the estimate (h) and the bias (b). * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Table 8: RDD estimates with a different outcome definition: Y=1 if 'Yes, absolutely', else Y=0

	(1)	(2)	(3)	(4)
Effect at cut-off	0.257*	0.301	0.104	0.120
Robust *p*-value	0.093	0.169	0.354	0.552
Robust 95% CI	[-0.045 ; 0.593]	[-0.119 ; 0.676]	[-0.138 ; 0.386]	[-0.266 ; 0.499]
Y right	0.501	0.382	0.514	0.434
Y left	0.244	0.081	0.251	0.190
BW loc. poly. [h] - left	14/03/21 05:23	14/03/21 04:57	14/03/21 09:11	12/03/21 05:04
BW loc. poly. [h] - right	26/03/21 14:36	29/03/21 04:42	27/03/21 06:37	30/03/21 14:30
BW bias [b] - left	11/03/21 07:31	11/03/21 18:13	12/03/21 01:57	09/03/21 19:59
BW bias [b] - right	01/04/21 22:45	01/04/21 14:42	02/04/21 16:27	02/04/21 07:27
Order loc. poly. [p]	1	2	1	2
Order bias [q]	2	3	2	3
Covariates	No	No	Yes	Yes
N	696	696	673	673
Eff. N estimate [h]	178	238	189	263
Eff. N bias [b]	340	326	329	344

Notes: The dependent binary variable is equal to 1 if the individual answers that they are willing to get vaccinated with certainty and 0 otherwise. z is the running variable on the ending time of the survey, with a cut-off at 17:00 on the 18th of March. We follow Calonico et al. (2014) with the following options: triangular kernel; variance–covariance matrix estimated using the heteroskedasticity-robust nearest-neighbour variance estimator. Different models: (1) local linear polynomial regression based on the MSE-optimal bandwidth selector for each side of the cut-off, (2) local quadratic polynomial, (3) local linear polynomial regression adding covariates, (4) local quadratic polynomial adding covariates. The table shows the optimal bandwidth for each side of the cut-off for the estimate (h) and the bias (b). * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Figure 4: Evolution of the vaccination rates (at least one dose) in Israel and in the US



Notes: Source: https://ourworldindata.org/covid-vaccinations