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Leadership Communication and COVID-19 Vaccination Hesitancy

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Abstract

This paper empirically analyzes the impact of leadership communication on the COVID-19 vaccination rate using a quasi-experimental design. Based on a speech of the President of France, Emmanuel Macron, we examine how political leaders can influence the willingness to get vaccinated of a country's citizens by transmitting scientific insights into a clear and vivid message as well as by threatening credibly with future restrictions for unvaccinated people. In a Difference-in-Differences (DiD) framework it is shown that a televised address of Macron has increased the vaccination rate in France by roughly 5%. We test the robustness of this result by applying an event study design. Our findings imply that leadership communication is an effective weapon to change the beliefs of unvaccinated citizens and to overcome COVID-19 vaccination hesitancy.

Keywords: COVID-19, leadership communication, vaccination, DiD

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1 Introduction

Two years after the World Health Organization was informed about the outbreak of the SARS-Cov-2 virus in Wuhan (China), the COVID-19 crisis still has a dramatic impact on people's health and the economy worldwild. By the time this paper was written, there have been more than 400 million confirmed cases and almost 6 million fatalities in connection with COVID-19 throughout the world.[1]

Vaccination campaigns have started around the world one year ago. Vaccination is a central pillar to bring the pandemic under control if the vaccines are given to enough people.[2] The four primary COVID-19 vaccines in Europe have been shown to be effective at preventing COVID-19 infections, hospitalizations, and deaths (Liang et al., 2021; Jabłońska et al., 2021).[3] As of February 15, 2022, less than 75 percent of the people in the European Union have received at least one vaccine dose, with large variation across the 27 countries.[4]

Even though the used vaccines are free of charge and highly effective, vaccine hesitancy remains prevalent in many states (Dror et al., 2020; Lazarus et al., 2021; Sallam, 2021). Despite ample evidence that vaccination reduces the probability of infection, hospitalization and death, there are many people who choose not to get vaccinated (Thorp, 2020). Possible reasons are mani-

[1] See https://covid19.who.int/.

[2] Models predict that at least 70 percent of the population have to be vaccinated in order for the incidence of infection to decline (Randolph and Barreiro, 2020).

[3] For instances, the Robert Koch Institute (RKI) has stated that vaccinations during the "third wave" prevented over 706,000 new cases of infection and 38,300 deaths in Germany (see https://bit.ly/3lKUWQI).

[4] See https://ourworldindata.org/covid-vaccinations.

fold. For instance, concerns about vaccine safety, effectiveness and side effects contribute to vaccine hesitancy (Fisher et al., 2020). In a poll conducted in the United States in September 2020, 62% of the respondents worry that political pressure would lead to a rush to approve vaccines without proper attention to safety and effectiveness (Newsroom, 2020). Beyond, many individuals share false information about the vaccines (e.g., about their alleged side effects) on social media (Marco-Franco et al., 2021).

From an economics perspective, vaccination against COVID-19 poses a positive externality: an individual who decides to get vaccinated does not only increase its own utility due to a decreased probability of getting infected, but also confers significant benefits (spillover benefits) on others (e.g., due to a reduced virus transmission (Shah et al., 2021) or a lower probability of a hospitalization (= lower burden for the health care system) (Nasreen et al., 2021)).[5] Against this background, economic theory predicts that vaccination remains at a suboptimal level because externalities are not internalized. This justifies governmental intervention. The national governments organize the vaccine procurement and allocation as well as subsidize the vaccinations (most of the developed countries offer vaccination free of charge for their citizens). Moreover, some policy makers have implemented incentive programs to nudge unvaccinated citizens to receive a COVID-19 vaccine (e.g., the "Vax-a-Million" lottery in Ohio, see Brehm et al., 2021).

[5]To the time this paper was written, the omicron variant is rapidly spreading worldwide. Even though the protection after the primary two dose series of the approved vaccines is lower for this variant compared to previous COVID-19 variants (Pajon et al., 2022), Wratil et al. (2022) have shown that three exposures to the spike protein of SARS-CoV-2 by either infection or vaccination can also induce high-quality antibodies against omicron. So, vaccination is still the most effective way to protect people against an infection.

The COVID-19 crisis is characterized by a high degree of volatility, uncertainty, complexity, and ambiguity so that leadership has become especially important. Political leaders should exert their influence by promoting what science has to say, clearly communicate evidence-based policies and inducing individuals to act in ways that benefit the collective (Antonakis, 2021; Chou and Budenz, 2020; Rzymski et al., 2021; Soares et al., 2021; Galasso et al., 2022). Different studies have figured out that leader's charisma - the ability to transmit information in a symbolic, value-based, and emotional manner - can get individuals to undertake personally costly but socially beneficial actions so that in the end coordination problems can be solved (Antonakis et al., 2021; Bastardoz and Van Vugt, 2019). With respect to the COVID-19 crisis, Jensen et al. (2021) have shown that charisma of US governor speeches had significantly increased physical distancing of US citizens. Hence, beside altering the cost-benefit calculation of individuals about whether to receive the vaccine, in times of a relatively high vaccine hesitancy it is also a key challenge for policy makers to change the beliefs of unvaccinated citizens.

Another important tool for political leaders which might accelerate the vaccination campaign is the credible threat of future restrictions for unvaccinated people (see Walkowiak et al., 2021). Such strict, punitive measures could be a restricted access to restaurants, sport facilities, indoor events or public transport for people without a proof of vaccination or recovery. Thereby, to be effective it is important that political leaders have a high credibility and that there is a sufficient public trust in the government measures (Bargain and Aminjonov, 2020; Gesser-Edelsburg et al., 2020).

In this study we examine the impact of leadership communication on

the daily vaccination rate by using a quasi-experimental design. On July 12, 2021, the President of France, Emmanuel Macron, gave a televised address broadcasted by all important French television channels and watched by more than 22 million citizens.[6] In his speech, he particularly emphasized the importance of getting vaccinated (*"A summer of mobilization for vaccination. That is what we must aim for."*) as well as announced compulsory vaccination for healthcare workers and future restrictions for unvaccinated people. We estimate the impact of this speech on the daily vaccination rate in France in a Difference-in-Differences (DiD) approach using Germany as a control group. Germany is an appropriate control group because, on the one hand, it is very similar to France with respect to geographical, economic and cultural aspects and, on the other hand, the German political leaders missed it to urge their citizens to get vaccinated and to announce extensive restrictions for unvaccinated people in a speech with a similar coverage in the summer 2021.[7]

The rest of the paper is structured as follows. In Section 2, we compare the COVID-19 vaccination campaigns of France and Germany. Our dataset and econometric methods are presented in Section 3. The results of our DiD analysis are outlined in Section 4. In Section 5, we conclude with the policy implications of our research.

[6] See https://bit.ly/3cld6n1.
[7] See https://bit.ly/3oylsyw.

2 Vaccination Campaigns

The administrative and logistical challenges of distributing the COVID-19 vaccinations have been substantial in France as well as in Germany. Both countries are relatively large both in terms of area and population, have a relatively old population and a health care system which is not as efficient as for example the digitized health care system in Israel (Rosen et al. 2021). In this chapter, we describe the vaccination campaigns of France (Section 2.1) and Germany (Section 2.2).

2.1 France

In France, 53 million inhabitants (equivalent to 78.7% of the whole population) are fully vaccinated and 54.1 million citizens (80.3%) have received the first dose (data as of 15 February, 2022).[8] In comparison to the other EU countries, France ranks eighth when it comes to both first and second shots.[9] In addition, France has started to administer booster doses at the beginning of September 2021 and has reached 34.4 million booster vaccinations (51%) so far.

The COVID-19 vaccination roll-out in France started on December 27, 2020 and is mapped in Figure 1. As in most of the countries of the EU, four different vaccines against COVID-19 have been used: the mRNA vaccine from BioNTech-Pfizer (Comirnaty, approved by the European Medicines Agency (EMA) on December 21, 2020), the mRNA vaccine from Moderna (Spikevax, January 6, 2021), the vector vaccine from AstraZeneca (Vaxzevria, January

[8] See https://covidtracker.fr/vaccintracker/.
[9] See https://ourworldindata.org/covid-vaccinations.

29, 2021) and the vector vaccine from Johnson & Johnson (Janssen, March 11, 2021).[10]

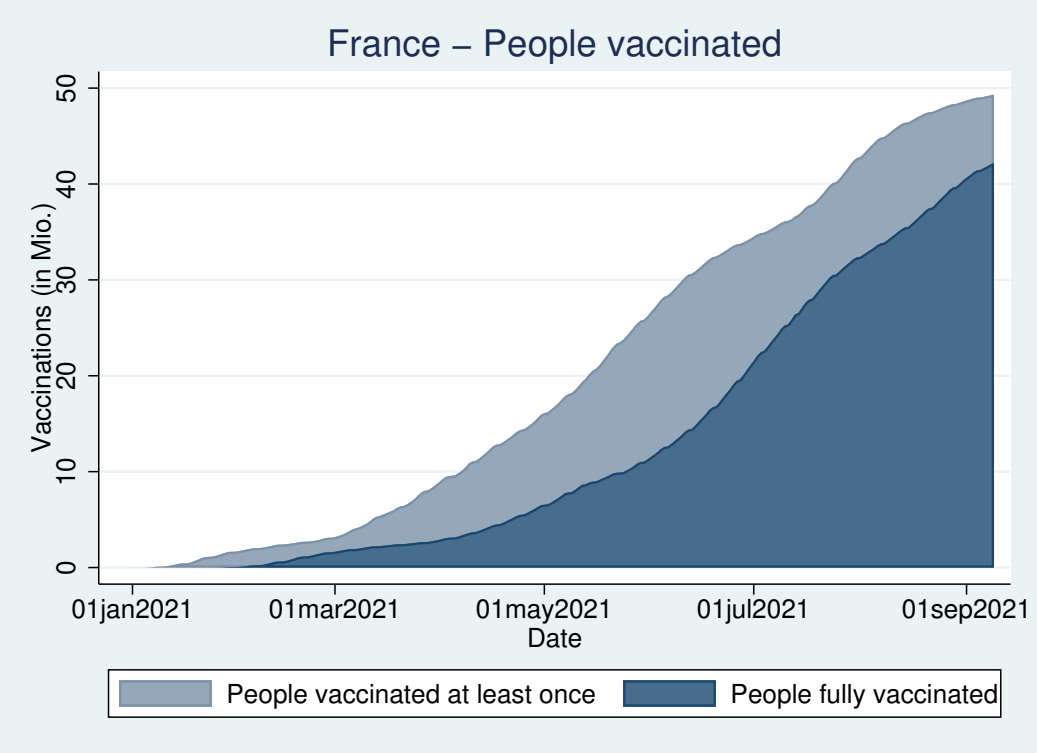

Figure 1: Vaccination campaign in France (Source: Our World in Data).

The French government planned to distribute the vaccine in four phases. In phase 1, nursing home and ESMS residents as well as caregivers and firefighters over 50 have been vaccinated. In the second phase, starting from January 18, 2021 on, people aged 75 and over were able to get vaccinated. From the end of February, the vaccination has been opened to citizens between 65 and 74 as well as for people from certain occupational groups in phase 3. In the fourth phase, the vaccination has been opened to those over

[10]In France, BioNTech/Pfizer has delivered the vast majority of vaccine doses (111m), followed by Moderna (46.7m), AstraZeneca (10.7m) and Johnson&Johnson (3.4m) (see https://covidtracker.fr/vaccintracker/).

18 years.

Similar to Germany, particularly mobile vaccination teams have been deployed to inject nursing home and ESMS residents at the early stage of the vaccination campaign. Afterwards, more than 1,000 vaccination centers have opened in all of France by the end of January 2021.[11] Moreover, France has started to integrate general practitioners much earlier than Germany as around 30,000 general practitioners were allowed to vaccinate by the end of February.[12]

However, the vaccination campaign in France, which actually has a well-financed and normally efficient health system, has been very slow at the beginning. Beside the issues in combination with the failed joint-procurement approach of the EU member states (see Section 2.2), particularly the low trust of French citizens in their health policy makers, the high degree of bureaucracy in the centralised French system and the surprisingly strong anti-vaxxer sentiment in France have slowed down the campaign.[13] For instances, a representative cross-sectional study from the end of 2020 has found that only 30.5% of the French respondents would agree to get vaccinated against COVID-19 during the first semester of 2021 (Guillon and Kergall, 2021).

Also the undermining of the AstraZeneca vaccine had an effect on the French vaccination campaign. In January 2021, Emmanuel Macron described the vaccine as being "quasi-ineffective" in over-65s, later France has only administered it to older patients due to a particular type of very rare blood

[11] See https://bit.ly/3la55q2.
[12] See https://bit.ly/32nCZAU.
[13] See https://econ.st/3FNoZz2.

clot in young people.[14] All those factors led to a situation in which only 13% of the French population got at least one dose of COVID-19 vaccine by the end of March (for comparison, in the UK around 46% had a first shot at that time).

Apart from that, the French vaccination campaign had some early bright spots. The whole country has had a very efficient appointment system due to the partnership of the French government with the widely-used medical app Doctolib, one of France's most successful start-ups.[15] Additionally, the campaign has progressed relatively evenly in all regions of mainland France (in contrast to the German one, see Section 2.2). Lastly, also the share of French citizens who wanted a jab rose to 65% in March 2021.[16]

In the following months, the French government has effectively used leadership communication and restrictions for unvaccinated people to tackle vaccine hesitancy. On July 12, 2021, President Emmanuel Macron announced the introduction of a COVID-19 passport in a televised address watched by more than 22 million citizens. From August 2021 on, only those who were fully vaccinated, recovered from COVID-19 or had a negative test result would be allowed into cinemas, sport stadiums, restaurants, bars, shopping centers, nightclubs or on long-distance trains and flights. Beyond, he said that vaccination will be compulsory for all health workers (enforced from September on) and that COVID-19 tests will no longer be free from October 15, 2021 on.[17]

[14] See https://econ.st/3nShalw.
[15] See https://bit.ly/3r8r4Bf.
[16] See https://econ.st/3xqOoeH.
[17] See https://econ.st/3HWfVJK.

In the hours following Mr. Macron's announcement, over 1 million citizens booked vaccination appointments via Doctolib. Three-fifths of the bookings have been for people aged between 18 and 39 years.[18] On July 28, 2021, France overtook Germany in terms of people who received at least one shot and today this figure is also higher than in the US or Britain. On the day of Mr. Macron's announcement, 54% of the French citizens had received at least one dose, by December 15, 2021 this figure was around 78%.

Despite this high vaccination rate, the number of COVID-19 cases and hospital admissions have been increasing in France in the end of 2021. As of December 15, 2021, the 7 day incidence rate equals 505.7[19] and the number of people currently in critical care is 2,792[20]. Those increasing number probably also motivated Emmanuel Macron to hold another televised speech on November 9, 2021, in which he again urged people to get vaccinated and announced that people over 65 years will now have to get a booster shot to remain eligible for the vaccine passport.[21]

2.2 Germany

As of 15 February 2022, at least 62.3 million German inhabitants (equivalent to 74.9% of the whole population) are fully vaccinated and at least 63.3 million citizens (76.1%) have received the first shot.[22] In comparison to the other EU countries, Germany takes the 14th (11th) place when it comes to

[18] See https://econ.st/3xqOoeH.
[19] See https://bit.ly/3p3aMXI.
[20] See https://bit.ly/3DS4f8p.
[21] See https://nyti.ms/3l7j9jU.
[22] See https://bit.ly/32qkJXN.

first (second) shot.[23] Beyond, roughly 88% of the vulnerable group (people older than 60 year) are fully vaccinated and at least 46.2 million booster vaccinations (55.6%) have been conducted so far.

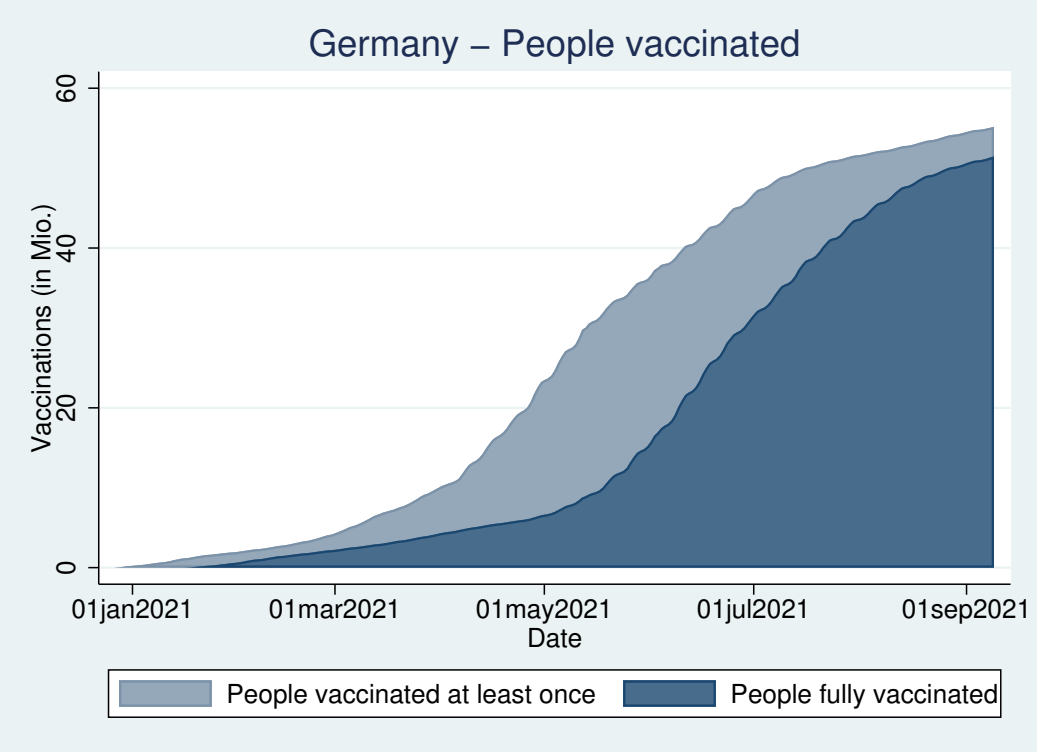

Figure 2: Vaccination campaign in Germany (Source: Our World in Data).

Likewise, the vaccination roll-out in Germany started on December 27, 2020 and the four vaccines approved by the EMA have been used during the vaccination campaign.[24] The progress of the German vaccination campaign is shown in Figure 2. The German government has implemented a prioritization scheme with three different groups: at first, people over 80, residents in care homes and medical staff have been vaccinated. The second group, including

[23] See https://ourworldindata.org/covid-vaccinations.

[24] BioNTech/Pfizer has delivered the vast majority of vaccine doses (137.1m), followed by Moderna (34.3m), AstraZeneca (14.4m) and Johnson&Johnson (5.4m) (see https://bit.ly/32qkJXN).

people between 70 and 80 years, patients with certain diseases as well as staff in daycare facilities for children and primary schools, was vaccinated from March 4, 2021 on. Lastly, in the third group there have been citizens between 60 and 70 years and people from certain occupational groups. The vaccination prioritization has been abandoned on June 7, 2021.

At the early stage of the vaccination campaign, in particular mobile vaccination teams have been deployed to inject the elderly people. The federal states then have opened large vaccination centers at the beginning of 2021. Overall, 400 vaccination centers with more than 10,000 physicians were established.[25] The vaccination process was mainly based in those centers until the beginning of April 2021, when general practitioners were integrated into the campaign. Later, also company physicians have started to support the vaccination campaign.

The German vaccination campaign was accompanied by several issues. At the early beginning there was a vaccine shortage due to the failed joint-procurement approach of the EU member states leading to a situation in which the European countries had relatively less vaccine doses compared to, e.g., the United Kingdom or the US.[26] Furthermore, the vaccination campaign was slowed down relatively early due to the undermining of the AstraZeneca vaccine. While in January 2021 the Standing Committee on Immunisation (STIKO) has first recommended to use this vaccine only for citizens below 64 years due to a low effectiveness at older people[27], the same institution has suggested to use it only for citizens above 60 years due to the

[25] See https://bit.ly/3qNw5iu.
[26] See https://econ.st/2Zb8n4q.
[27] See https://bit.ly/36lPdfD.

occurrence of rare but very severe embolic side effects in March 2021.[28] This act has unsettled many German citizens so that this vaccine has become a shelf warmer.[29]

There have occurred further issues in several German federal states in connection with inadequate appointment systems. Studies from the US and Israel have revealed the importance of using online communication effectively to increase the speed of a vaccination campaign (Tewarson et al., 2021), but also suggested to address disadvantaged groups who are excluded from the digital world (McKee and Rajan, 2021). However, the German federal states have chosen very different appointment systems[30] and many German citizens failed due to overloaded hotlines or booking platforms.[31]

Until the end of March 2021, only 5% of the German citizens were fully vaccinated. The speed of the vaccination roll-out has only increased when 35,000 general practitioners were officially integrated into the campaign in the early April.[32] Even though administering vaccines doses is associated with a relatively high degree of bureaucratic burden for the general physicians, they have apparently accelerated the German vaccination campaign (Götz et al., 2021).

Within the federalist Germany, the vaccination speed and efficiency of the 16 federal states differ significantly. While in Bremen already 87.8% of the citizens are fully vaccinated, Saxony has only fully vaccinated 63.6%

[28] See https://bit.ly/30PZBJK.
[29] See https://bit.ly/3FF2PP8.
[30] See https://bit.ly/2ZbDwVo.
[31] See https://bit.ly/32envz4.
[32] See https://bit.ly/3HPf2D1.

of the population so far.[33] In part, the federal states have pursued very distinct strategies with respect to, e.g., prioritization of first or second shot, the integration of local firms or the administration of appointments. Using a Data Envelopment Analysis (DEA) to analyze the relative efficiency of the German federal states, Götz et al. (2021) have examined that vaccinations would have been 3.4-6.9% higher between January and May 2021 if all federal states had adopted the strategy of the most efficient states. Those authors (ibid.) also conclude that the German vaccination campaign appears to be characterized by a high degree of bureaucracy.

On July 26, 2021, 50% of the German population was fully vaccinated. However, vaccination hesitancy has been a big issue in Germany in the following weeks and months. While in the early stage of the campaign vaccine shortage was a problem, now the demand for vaccinations was lower than the supply and the vaccine reserves increased drastically week by week. In calendar week 30 (July 26- August 1, 2021), 16.27 million doses were in the German vaccine stock.[34] This constitutes jabs for approx. 20% of Germany's population. At that time many federal states also decided to close most of the vaccination centers, which later has led to missing capacities when the booster vaccinations have started.[35]

Between July and September 2021, a period which was characterized by low incidences and the federal election campaign, the German policy makers did not transmit scientific insights to the citizens and did not prepare the country for the following winter sufficiently. As early as July 22, 2021,

[33] See https://bit.ly/32qkJXN.
[34] See https://bit.ly/32qkJXN.
[35] Seehttps://bit.ly/3oRwHRD.

the Robert Koch Institute (RKI) has published a document in which it has warned of a fourth wave in the upcoming autumn/winter and requested the policy makers to make arrangements to mitigate this wave.[36] In detail, the biomedical research institution of the German government requested to pursue a highest possible vaccination rate, to plan and prepare booster vaccinations and to timely inform the citizens about a possible heavy burden on the healthcare system in the upcoming winter.

Nevertheless, contrary to France the German policy makers missed it to effectively urge their citizens to get vaccinated, to announce extensive restrictions for unvaccinated people in the public area and to prepare booster vaccinations punctually. Hence, as of December 15, 2021, the 7 day incidence rate equals 353[37] and there are approx. 4,800 intensive care treated COVID-19 patients[38].

3 Data and Methodology

We use a panel dataset recording data on daily vaccinations at the country level from "Our World in Data" publicly available on github.com.[39] Besides data on vaccinations, this dataset also includes data on COVID-19 cases, deaths, hospitalizations and testing as well as socio-economic variables. Data on COVID-19 vaccinations is available for 218 countries, however, we only use the daily vaccination rates for France and Germany. Our period of investigation starts on December 27, 2020 (when the vaccination campaigns have

[36] See https://bit.ly/3nJda6w.
[37] See https://bit.ly/30StFnM.
[38] See https://bit.ly/3r7RByH.
[39] https://github.com/owid/COVID-19-data/tree/master/public/data .

begun in both countries) and ends on September 9, 2021.

To examine whether the televised address from Emmanuel Macron from July 12, 2021 was effective in increasing the vaccination readiness of French citizens we apply a difference-in-differences (DiD) approach. The DiD design is a quasi-experimental identification strategy for estimating causal effects by comparing the difference across time in the differences between outcome means in the control and treatment groups (see, e.g., Angrist and Pischke (2008), ch. 5). Thereby, Germany is used as the control group due to the very similar socio-economic conditions and no similar leadership communication in conjunction with vaccination hesitancy (see Section 2).

The empirical baseline model we estimate can be written as:

$$v_{it} = \alpha + \gamma FR_i + \phi Post_t + \delta FR_i \times Post_t + \lambda_t + \epsilon_{it}, \tag{1}$$

where v_{it} is the share of people who received at least one vaccine dose in country i on day t.[40] The variable of interest is δ - the effect of Macron's televised speech on the share of people who received at least one vaccine dose v_{it}. We further include the dummy variable FR_i which is equal to 1 if the observation is from France and an indicator variable for the post-speech period ($Post_t$). The time effects are taken into account through the inclusion of a linear time trend λ_t in our model and ϵ_{it} is the idiosyncratic error term.

To assess the robustness of our findings, we estimate four additional versions of Equation (1). First, we augment our DiD regression by adding linear

[40] We use this figure and not the share of fully vaccinated people since we want to measure the impact of Macron's speech on vaccine hesitant people who have not already got a first shot. Beyond, those who do receive a first shot in response to the speech are not fully vaccinated for at least additional three weeks.

country-specific time trends in order to allow for different general developments over time across the both countries (see Wolfers (2006)). Second, we include monthly and weekday time-fixed effects instead of the linear time trend to control for a distinct time pattern. Third, in order to control for "bad news", we integrate the lagged number of new COVID-19 cases (per million inhabitants, lagged by one week) as a control variable. Lastly, we also estimate Equation (1) by using the daily change rate of the vaccination share ($v_{i,t} - v_{i,t-1}$) instead of the absolute number.

Moreover, we apply a DiD event study (dynamic DiD model) to further check the robustness of our results (see, e.g., Cunningham (2021), ch. 9.4) . The key identification assumption of our DiD approach is that, in the absence of the Macron speech, the trends in the daily vaccination rates would have been the same in France and Germany. The event study allows for a pattern in vaccination rates leading up and following the speech of Macron so that we can see whether there is an effect, and how long it lasts. We include nine interaction terms comprised of an indicator for whether the country is France and indicators for each of the three weeks before and six weeks after the Macron speech. The week of the televised speech is the omitted group, yielding the following equation:

$$V_{it} = \gamma_i + \lambda_t + FR_i \times [\sum_{k=-3}^{-1} \pi_k 1(Week_t = k) + \sum_{k=1}^{6} \rho_k 1(Week_t = k)] + \epsilon_{it}, \quad (2)$$

where V_{it} is the number of people per 100 residents who received at least

one vaccine dose in country i on day t.[41] The variable λ_t depicts a linear time trend and γ_i represents country-level fixed effects accounting for country-level characteristics that do not vary over time. The coefficients π_k and ρ_k provide the estimated change in vaccination rates relative to the week of Macron's speech ($k = 0$). Estimates close to zero on the interaction term π_k in the pre-speech weeks provide evidence against concerning pre-trends.

4 Results

Before we present the estimation results we illustrate the vaccination progress for both countries descriptively. We plot the trends of the daily vaccination rates (people who have got at least one vaccine dose) for our observation period in Figure 3. Visual inspection suggests that the parallel trend assumption can be credibly maintained. The two curves evolve similarly at the beginning of the vaccination campaigns before Germany has a small advantage between the end of April and mid-July. This figure also shows a visible rise in the daily vaccination rate of France after the speech of Macron.

The results from regression equation (1) and some extensions are shown in Table 1. The dependent variable in those regressions is the share of people who received at least one vaccine dose. In column (I), we report the DiD estimates of our baseline regression. We find a significant and positive average treatment effect on the treated (ATET) of 0.049 (variable DiD), which means that France had a 4.9% increase in the vaccination rate relative to a

[41] We now use this variable instead of the share of people who received at least one vaccine dose (c.f. Equation (1)) since so we can compute the absolute effect of Macron's speech based on our DiD event study more easily (see Section 4).

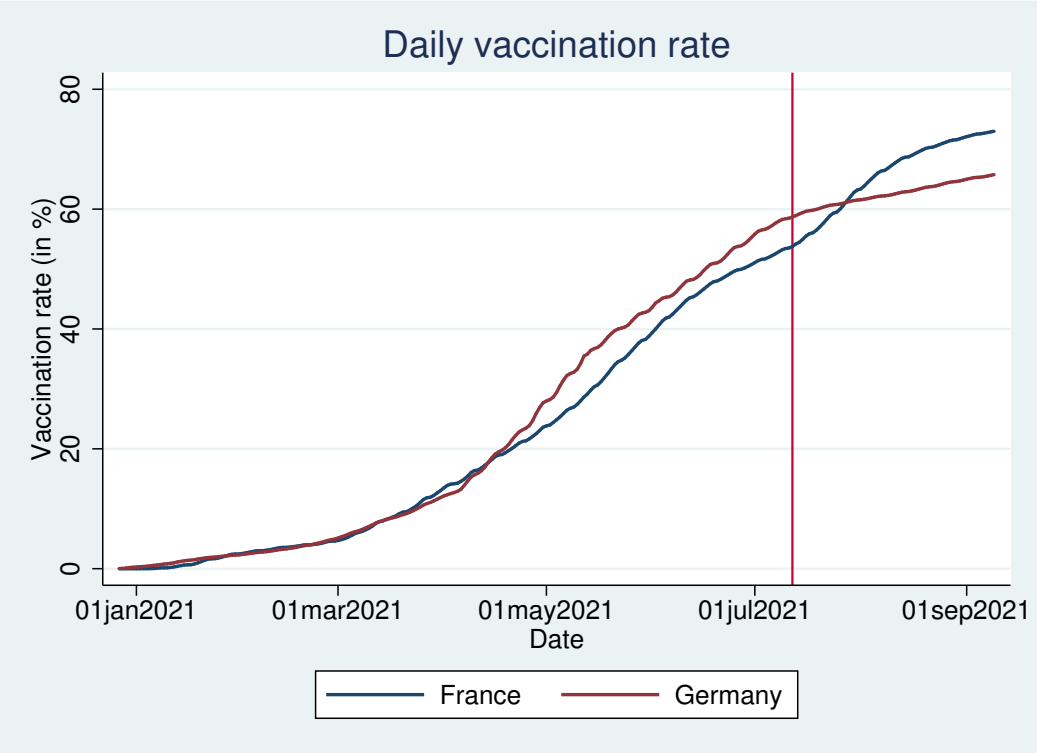

Figure 3: Progress of vaccination rates in France and Germany (Televised address of Macron on July 12, 2021).

(counterfactual) scenario where Macron did not hold his speech. The coefficient of the variable *Post* in our baseline scenario implies that there is no significant mean change in the vaccination rate from before to after the treatment among the control group, the coefficient of the variable *FR* means that there is a mean difference of approx. 2% between the vaccination rates of Germany and France prior to the speech of Macron and the significant time trend indicates a general increase over time in the daily vaccination rate of 0.3%.

	(I)	(II)	(III)	(IV)	(V)
Post	0.008	0.019*	-0.007***	-0.020	0.010
	(0.015)	(0.011)	(0.000)	(0.037)	(0.020)
FR	-0.018***	-0.018***	0.005***	-0.040***	-0.042***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.001)
DiD	0.049***	0.049***	0.079***	0.066***	0.059***
	(0.000)	(0.000)	(0.000)	(0.009)	(0.002)
Time Trend	0.003***			0.003***	
	(0.000)			(0.001)	
Lagged Cases				0.00002	0.00007***
				(0.00003)	(0.00001)
Constant	-0.098***	0.020***	-0.109***	0.064	0.496***
	(0.012)	(0.007)	(0.000)	(0.127)	(0.002)
Time Trend	Yes			Yes	
M&W FE		Yes			Yes
Country Time Trends			Yes		
Bad News				Yes	Yes
R-squared	0.9655	0.9852	0.9661	0.9489	0.8982
Obs.	514	514	514	202	202

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1: Difference-in-Differences estimation with share of people who received at least one vaccine dose as dependent variable.

Our result is also robust when we include monthly and weekday fixed effects (column (II) in Table 1) or country-specific time trends (column (III)) instead of a linear time trend. In the columns (IV) and (V), we include the lagged number of new COVID-19 cases (per million inhabitants) as a control variable for "bad news".[42] The intuition behind this control variable is

[42]We restrict the dataset for those specification from 1 June to 9 September so that we only have 202 observations here. The reason for that can be found in Figure 5 of Appendix A where the share of people who received at least one vaccine dose and the number of new COVID-19 cases (smoothed, per million) are plotted. In the period before 1 June, residents were not able to freely decide to get vaccinated due to vaccine shortage. So, Figure 5 shows that we had a third wave around March/April in both countries, but the vaccination rate did not rise sharply at that time due to the scarce vaccines. In the following summer months, the number of cases was decreasing and the vaccination rate has continued to rise, but only since people who wanted to get vaccinated anyway (and not based on their risk of infection) were vaccinated. So, to evaluate the relationship between the new COVID-19 cases ("bad news") and the vaccination rate it is better to start at a time where both countries had enough vaccines and no prioritization scheme.

that the incentive to get vaccinated of residents might increase with a higher occurrence of infection in their country. Indeed, we find a significant and positive effect of the number of new COVID-19 cases from last week (coefficient *Lagged Cases*) on the vaccination rate today when we use monthly and weekday fixed effects (column (V)), even though this variable is insignificant when a linear time trend is used (column (IV)). The effect of Macron's speech is again positive and significant in those specifications.

	(I)	(II)	(III)	(IV)	(V)
Post	-0.0046***	-0.0009	-0.0048***	0.0002	-0.0008
	(0.0003)	(0.0008)	(0.0000)	(0.0016)	(0.0009)
FR	-0.0003***	-0.0003***	0.0001***	-0.0003***	-0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)
DiD	0.0023***	0.0023***	0.0028***	0.0016***	0.0020***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0003)
Time Trend	0.00002***			-0.0001*	
	(0.0000)			(0.0000)	
Lagged Cases				0.0000035***	0.0000015
				(0.00000045)	(0.0000017)
Constant	0.0008***	-0.0008***	0.0006***	0.0136**	0.0022***
	(0.0002)	(0.0000)	(0.0000)	(0.0056)	(0.0003)
Time Trend	Yes			Yes	
M&W FE		Yes			Yes
Country Time Trends			Yes		
Bad News				Yes	Yes
R-squared	0.3188	0.7066	0.3210	0.4537	0.6758
Obs.	512	512	512	202	202

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Difference-in-Differences estimation with the daily change rate of people who received at least one vaccine dose ($v_{i,t} - v_{i,t-1}$) as dependent variable.

We further estimate equation (1) by using the daily change rate of the vaccination share ($v_{i,t} - v_{i,t-1}$) instead of the absolute vaccination share as the dependent variable. The corresponding results are shown in Table 2. Again we find a positive and significant effect for the televised speech of Macron between 0.16% and 0.28% depending on the exact regression model.

In our baseline estimation (column (I)), the Macron speech has increased the daily change rate of people who received at least one vaccine dose by 0.23% compared to a situation without such a speech.

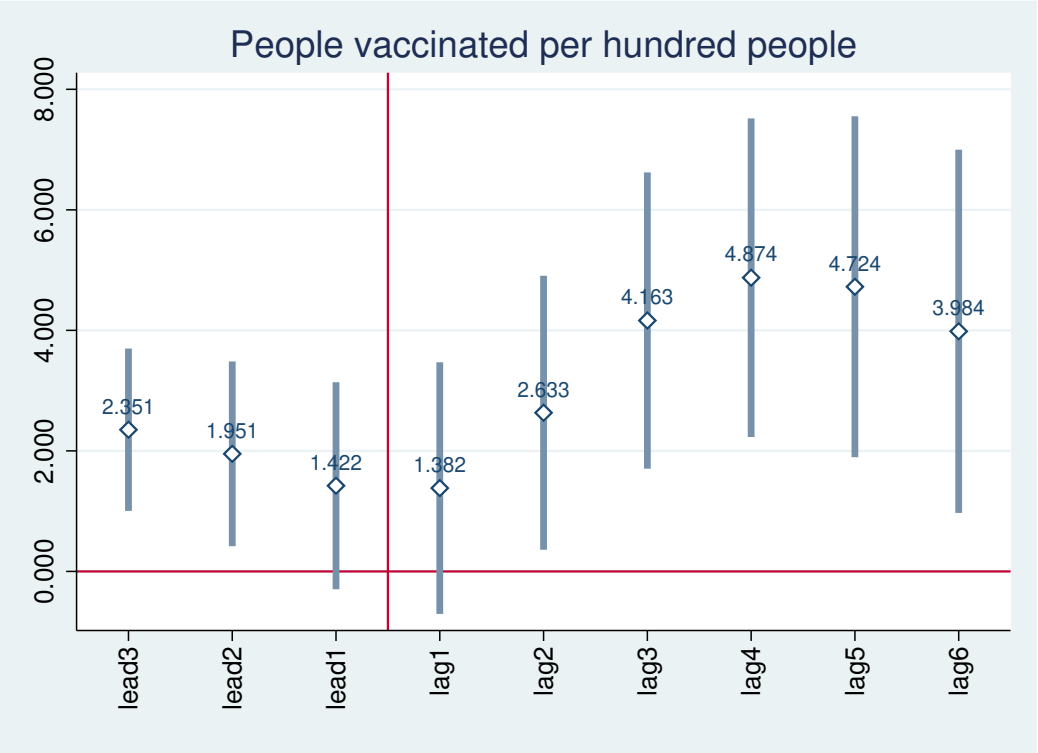

Figure 4: People who received at least on vaccine dose per 100 residents. The omitted group is the week of Macron's speech using weekly bins. The whiskers display 90 percent confidence intervals.

In order to check the robustness of our results, we additionally apply a DiD event study design. Figure 4 displays the estimates from the event study regression in equation (2). The estimated effects are relative to the week of Macron's speech and suggest that the speech has increased the daily vaccination rate in France between the second and sixth week significantly. The first week might be insignificant because even if some residents would have made a vaccination appointment just after the televised speech, it takes a few days to get the jab. The estimates imply the vaccination rate increased

by 2.6 (first) shots per 100 residents during the second week and by 4-4.9 (first) shots per 100 residents during the weeks three and six. The whiskers in Figure 4 present 90 percent confidence intervals.

We can use those event study estimates to generate an estimate of the approximate number of additional vaccinated residents induced by the speech. Scaling the found estimates to be statewide, we would find that the total number of additional vaccinated residents induced by the speech is 10.8 million ($67,390,000 \times \frac{2.6+4.2+4.9+4.7+4-2.4-2}{100}$) in the six weeks after the speech.[43]

5 Conclusion

This article asked whether political leaders can influence the decision of residents to get vaccinated against COVID-19. Since vaccination hesitancy is omnipresent in many countries, it is a key challenge for policy makers to nudge a reluctant population. Beside designing incentive programs to encourage COVID-19 vaccinations, changing the beliefs of unvaccinated citizens by transmitting scientific insights is an important task for political leaders. They should counter false information on social media by providing secure knowledge on the safety and effectiveness of the approved vaccines. Concurrently, the credible threat of future restrictions for unvaccinated residents might further increase the people's willingness to get vaccinated.

Our results imply that a televised speech by France's President Emmanuel Macron has increased the willingness of French citizens to get vaccinated by roughly 5%. Mr. Macron has pointed out the importance to get vaccinated

[43] We have subtracted the effect of the two (significant) leads from our overall effect to get a conservative number.

and announced extensive future restrictions for unvaccinated residents in his speech. Using an event study design, we find that this speech has increased the number of vaccinated citizens in France by almost 11 million in the first six weeks after the speech.[44]

Our findings are consistent with works that have explored the impact of leadership communication on solving coordination problems (see, e.g., Antonakis et al., 2021) and some newer studies that pointed out the effect of leader's charisma on the compliance with the COVID-19 rules (see, e.g., Jensen et al., 2021). However, it remains a task for future research to find the optimal remedies to rise the vaccination rate in different countries. Possibly, in countries outside France leadership communication is less effective compared to, e.g., financial incentives.

To the time this paper was written, there has been a great debate on the introduction of a statewide general compulsory vaccination in Germany. Since the German vaccination rate is still too low to hinder excessive demands on the national health care system, some policy makers think that this is the last remedy. However, this paper suggests that applying leadership communication can also be an effective weapon to change the beliefs of unvaccinated citizens and can possibly avoid the necessity of a general compulsory vaccination.

[44] An important remark is that our approach cannot identify whether the transmission of scientific insights in Macron's speech or the announcement of future restrictions for unvaccinated people has increased the willingness to get vaccinated in the French population.

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A Appendix

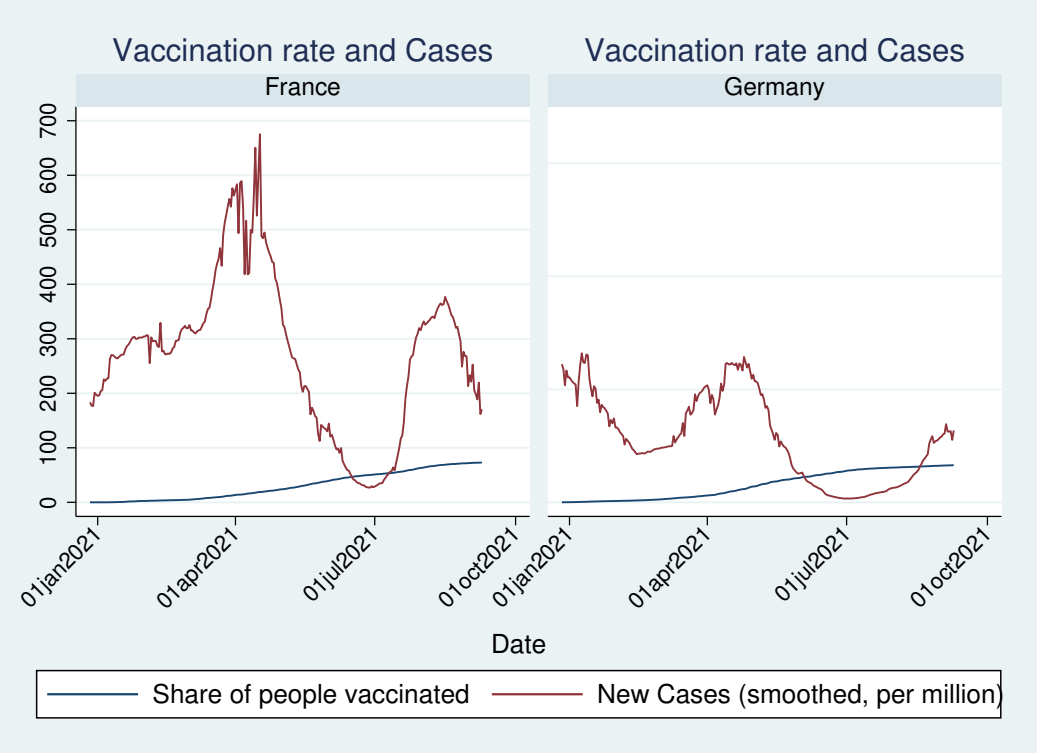

Figure 5: Share of people who received at least one vaccine dose (blue) and number of COVID-19 cases (smoothed, per million) (red) in France (left) and Germany (right).