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Has COVID-19 vaccination success increased the marginal willingness to pay taxes?

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Abstract
The COVID-19 vaccination campaign can be regarded as a public-sector success story. Given the shock caused by the pandemic, the highly visible and successful response of the public authorities in rolling out the vaccination might have elicited an increase in public trust. We test whether the vaccination process increased the marginal willingness to pay taxes (MWTP). Taking advantage of the different paths taken by the vaccination roll-out in Spain, we employ a difference-in-differences empirical strategy, complemented by an event study, to infer causality running from vaccination coverage to MWTP. We find an increase in MWTP caused by the good governance of the vaccination campaign.

KEYWORDS
survey data, marginal willingness to pay, difference-in-differences, event study, COVID-19

JEL CLASSIFICATION
D72, H20, H26, H30

1 | INTRODUCTION

The roll-out of the COVID-19 vaccination campaign can be regarded as a success story, highlighting the efficient organisation of contemporary societies and, particularly, of the public sector. On 17 June 2020, the European Commission (EC) issued a communication to the European Parliament stating that 'to help protect people everywhere and EU citizens in particular, the Commission is proposing an EU strategy to accelerate the development, manufacturing and deployment of vaccines against Covid-19'.[1]

[1] See 'EU Strategy for COVID-19 vaccines', COM(2020) 245 final, European Commission, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0245&from=EN.

Barely six months later, EC member states received their first doses of the Pfizer vaccine, with the first shipment arriving in Spain on 26 December 2020.[2]

Indeed, the development and manufacture of vaccines were achieved in a very short space of time, and their deployment received wide media visibility.[3] While vaccine delivery to member states was managed by the EC, it was the task of the former to design and implement their own domestic vaccination strategy.[4] In Spain, the goal of the strategy – the design of which lay in the hands of the Interterritorial Council of the National Health System (or CISNS in its Spanish abbreviation), a collegiate health-care body that draws on the participation of the leading health officials in the autonomous communities and the Spanish Health Minister – was to reduce morbidity and mortality in a context of the progressive availability of vaccine doses, while protecting the most vulnerable groups.[5] The effectiveness of the vaccines, the high degree of vaccination willingness manifest by Spanish society and the sound implementation of the domestic strategy (which included premises for mass vaccination, advertising campaigns, and overtime pay for health-care personnel) helped ensure a successful outcome (see, for example, Antonini et al., 2022).[6]

It would seem – and this is the hypothesis we seek to test here – that, given the shock generated by the pandemic, the highly visible and successful response of the public authorities in rolling out the vaccination served to elicit an increase in public trust. This, in and of itself, can be seen as a welcome result, a kind of 'double dividend', given the tendency of individuals to free ride with respect to the provision of public goods. Fehr (2009) proposes a behavioural definition of trust that comprises two elements: an individual who trusts (in this case, a taxpayer) when he voluntarily places resources at the disposal of another party (the public sector), but without any guarantee that these resources will be returned; and an expectation that this act of trust will be of direct benefit to him. While taxes certainly do not yield a direct individual benefit, the good governance of the vaccination roll-out may have increased expectations of better public sector performance in the future.[7] Indeed, this could well prove to be good news, confirming other empirical evidence that points to an increase in institutional trust arising from the outcome quality of public services (Van de Walle and Migchelbrink, 2022).[8]

In the specific case of taxation, the definition of trust by Slemrod (2002) focuses on the second element in Fehr's definition and suggests that trust is not unlike approval. Such a view is consistent (Oh and Hong, 2012) with an increasing marginal willingness to pay taxes (MWTP), that is, with an increase in taxpayer predisposition to contribute to the common good. This, we argue, is important because '[t]he challenge […] is to identify aspects of government expenditure and tax policies that mediate the free-rider impulse in an empirically important way' (Slemrod, 2002, p. 6). Meeting this challenge is the aim of the present paper, namely, to test whether the vaccination process – through increased institutional trust – has mediated the free-rider impulse and, thereby, increased MWTP.[9] In

[2] See https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/sanidad14/Paginas/2020/261220-llegada-primeras-vacunas-a-espana-contra-co.aspx.

[3] See, for example, https://elpais.com/sociedad/2020-12-27/araceli-hidalgo-96-anos-primera-vacunada-de-covid-en-espana-a-ver-si-conseguimos-que-el-virus-se-vaya.html.

[4] See 'COVID-19 vaccination strategy in Spain: key points', https://www.sanidad.gob.es/gabinetePrensa/notaPrensa/pdf/24.11241120144436287.pdf.

[5] It is striking how societies and the role of the public sector have changed over the last century. Between 1918 and 1920, Spain, like many other countries, was stricken by the so-called Spanish flu, which infected eight million people and claimed more than 300,000 lives throughout the country. However, none of the most influential Spanish politicians in power at the time mentions the pandemic in their political memoirs (de Riquer, 2022).

[6] By the beginning of 2023, 92.6 per cent of the population over the age of 12 had received all of the vaccine doses recommended by the public authorities. See also the euronews article, 'How struggling Spain became one of Europe's vaccination champions', https://www.euronews.com/my-europe/2021/09/03/how-struggling-spain-became-one-of-europe-s-vaccination-champions.

[7] One important characteristic of the vaccination process that enhanced the chances of increasing trust was the visibility of the whole process (Bouckaert, 2012, p. 105), including the final stage, which opened up premises for mass vaccination.

[8] See also figure 6.3 of Murtin et al. (2018, p. 44).

[9] Certainly, there might also be an increasing demand for a 'different type of state: one that is able to act as an investor of first resort, catalysing new types of growth and, in so doing, crowd in private-sector investment and innovation – these are in essence functions about expectations about

a similar vein, Lachapelle et al. (2021) tested whether, in the general context of COVID-19, people were willing to pay, in this case, earmarked taxes;[10] in their particular setting, the hypothesis was based on the existence of generalised social trust rather than institutional trust. However, they found little evidence of increased MWTP even during a pandemic.

Here, by exploiting the different paths, based on age, taken by the vaccination roll-out in Spain, we adopt a difference-in-differences (DiD) empirical strategy – complemented by an event study – to infer causality running from vaccination to MWTP. To estimate MWTP, we conducted a survey comprising 2,000 observations in May 2020 in Spain during the lockdown caused by COVID-19. The same survey was conducted in three subsequent waves every six months to analyse the evolution of MWTP over time. MWTP is a discrete variable that identifies individual preferences toward taxation (lower, equal or higher burden) contingent on the impact on public good provision. We find robust empirical evidence of an increase in MWTP for individuals in age groups presenting a higher vaccination coverage at the time of the survey. This allows us to conclude that good governance related to the COVID-19 vaccination roll-out mediated the free-rider impulse in an empirically important way.

The rest of the paper is organised as follows. In Section 2, we describe the survey data used in the empirical strategy and the logistics of vaccination in Spain, while in Section 3, we present the empirical strategy itself. Subsequently, in Section 4, we set out the main results and robustness tests. Section 5 draws together our conclusions.

2 | SURVEY DATA AND VACCINATION ROLL-OUT IN SPAIN

To test our hypothesis, we employ survey data. As Table 1 shows, we use four survey waves. The first was conducted in May 2020 during the official lockdown imposed by the Spanish government in response to the COVID-19 pandemic and which was kept in place from 13 March to 25 June 2020. The three subsequent waves were conducted at six monthly intervals. Each of the four waves was conducted online, and monitored and processed by a professional survey firm, Netquest, which guarantees access to a broad, high-quality panel of potential respondents.[11] Participation was by invitation only and all participants in one wave were excluded from subsequent waves. The survey insisted on the importance of sincerity in responding and a quality check item was incorporated as a guarantee of respondent attention. Additionally, any responses for which the time of response was 20 per cent faster than expected were excluded from the sample. Respondents were over the age of 18, resided in Spain, and were rewarded by means of in-kind compensation.

TABLE 1 Survey waves and vaccination campaign.

Wave	Number of responses	Date	Vaccination campaign in progress
1	2,003	20–26 May 2020	No
2	2,024	20–25 November 2020	No
3	2,001	26 May to 7 June 2021	Yes
4	*2,409*	*3–9 December 2021*	*Yes*

future growth areas' (Mazzucato and Kattel, 2020, p. 2). Such a demand would be compatible with a large-scale public sector, which is the focus of the present study. See also Rota-Graziosi and Arezki (2021).

[10] Their analysis was, likewise, survey-based. The survey question employed was the following. 'If the federal government were to propose imposing a new tax to fund massive spending to [revive Canada's economy/fight the spread of Covid-19 (coronavirus)], to what extent would you agree or disagree with supporting this policy [if the tax represented 1%/2%/5%/10% of your current income]?' Hence, the tax revenue could be 'hypothecated' for either stabilisation purposes or public health issues, depending on the random sample.

[11] See https://www.netquest.com/en/online-surveys-investigation.

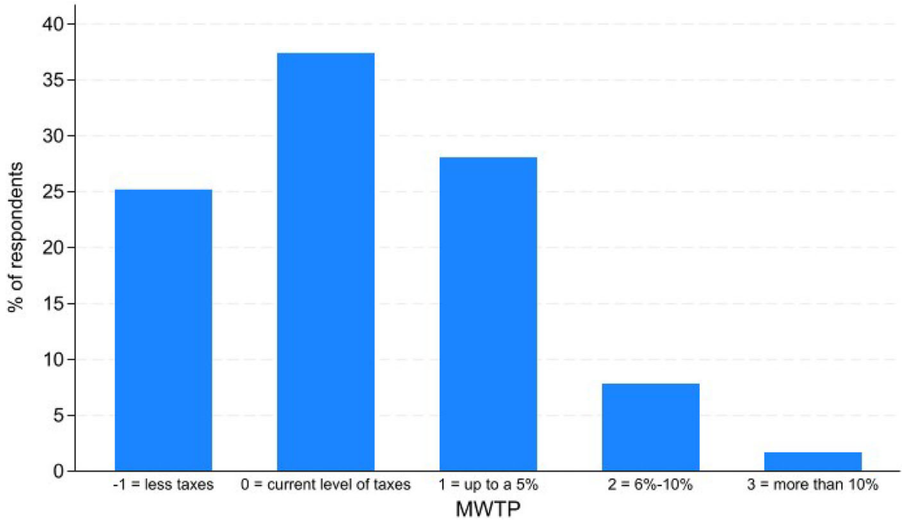

FIGURE 1 Percentage distribution of MWTP responses from survey data.
[Colour figure can be viewed at wileyonlinelibrary.com]

We code the variable MWTP from the survey question that reads as follows:

> Some people think that public services and social benefits should be improved, although this implies higher taxes (group 1). Others think it is more important to pay less taxes, although this implies a lower level of public services and social benefits (group 2). Others consider that the current level of taxes and of public services and social benefits is adequate (group 3). Which group is closest to your preferences?[12]

MWTP = −1 (for those self-selecting in group 2) and 0 (for group 3). Those self-selecting in group 1 responded to an additional question that allowed us to code MWTP as follows: +1 (those willing to pay up to an additional 5 per cent of their annual income), +2 (between 6 and 10 per cent of their annual income) and +3 (more than 10 per cent of their annual income). Thus, MWTP is a discrete variable running from a negative attitude to pay taxes (−1) to a maximum attitude (+3). Figure 1 shows that 25 per cent of the respondents are willing to pay less tax than the status quo (MWTP = −1), 37 per cent reply that the current level of taxes is in line with their preferences (MWTP = 0), 28 per cent express their willingness to pay up to 5 per cent more of their annual income (MWTP = +1), 8 per cent are willing to pay between 6 and 10 per cent more (MWTP = +2) and only 2 per cent are willing to pay more than the 10 per cent of their annual income (MWTP = +3).

We also built up a variable with three MWTP values (−1, 0 and +1). That is, we collapsed all responses where MWTP > 0 into +1, independently of the level of their intensity.

The question was administered to a subsample of each wave, representing 20 per cent of all the surveyed population. Specifically, it included all the representative ages of the Spanish population from 18 to 87 years of age.

The COVID-19 vaccination campaign in Spain was launched in December 2020, just days after the European Medicines Agency (EMA) authorised the first vaccine. The first doses were distributed among the most vulnerable, in line with an official vaccination strategy approved by a CISNS technical

[12] In Spanish, '*Algunas personas piensan que deberían mejorarse los servicios públicos y las prestaciones sociales, aunque haya que pagar más impuestos (grupo 1). Otras piensan que es más importante pagar menos impuestos, aunque eso signifique reducir los servicios públicos y prestaciones sociales (grupo 2). Otras consideran que ya está bien el nivel actual de impuestos y de servicios públicos y prestaciones sociales (grupo 3) ¿En qué grupo te situarías?*'

TABLE 2 Percentage of people having received the full course of vaccinations by age.

	Age group					
	≥80 years	**70–79 years**	**60–69 years**	**50–59 years**	**25–49 years**	**18–24 years**
26 May 2021 (third wave)	99.8%	85.2%	11.7%	8.7%	5.2%	2.7%
2 December 2021 (fourth wave)	100%	99.8%	99.3%	95.4%	85.1%[1]	84.8%[2]

Note: [1] 30–49 years; [2] 12–29 years. *Source*: REGVACU, Ministry of Health, Spain.

team, who monitored and regularly updated the strategy in the weeks that followed. Thus, on 18 December 2020, vaccination began among the residents and personnel of care homes, front-line health-care workers and the highly dependent. On 21 January 2021, it was expanded to include those aged 80 and over. On 9 February, vaccination began among members of the security forces and schoolteachers. On 26 February, vaccination programmes were initiated among those aged 70–79, 60–69 and those below the age of 60 but deemed to be at high risk. Later, some changes were made in order to adapt to prevailing medical circumstances. Thus, as of 30 March 2021, the 60–69 age group was expanded to include those aged over 56, and as of 20 April it was further expanded to include those aged 50 and over. Inclusion in a group meant individuals were eligible for vaccination; however, the pace of vaccination varied across Spain's autonomous communities and across age groups. Normally, the younger an individual, the later they received the vaccine. Here, we exploit the different speed in vaccination coverage to estimate the impact on the MWTP.

As Table 2 shows, by 26 May 2021, when the third wave of the survey was conducted, the percentage of individuals in the two oldest groups (i.e. aged 70 and over) who had completed the vaccination course was extremely high (ranging from 85.2 to 99.8 per cent). However, among individuals aged 60–69, the percentage that had received the full course by this same date stood at just 11.7 per cent, while the percentage was even lower in younger age groups. Six months later, when the fourth wave of the survey was conducted, most individuals in the younger age groups had also completed the course. Thus, at the time of the first and second waves of the survey, the vaccination campaign had not begun; by the third wave, almost all individuals over the age of 70 had received the full vaccination course; while, by the time the fourth wave of the survey was conducted in December 2021, all adult groups had been given the opportunity to receive the full course of vaccinations. Therefore, for our empirical strategy, the fourth wave cannot be used to estimate causality because we would not have a control group.

By way of a preliminary analysis, it is interesting to compare the average MWTP values of respondents aged 70 and over with the corresponding values of respondents up to the age of 70 in each of the four survey waves (Figure 2). The MWTP was higher for respondents under the age of 70 when the vaccination campaign had yet to be launched (first two waves), but was notably higher for respondents aged 70 and over in the third wave, when most individuals in this group had completed their vaccination course but only a small minority of those under 70 had (Table 2).[13] Six months later, when the vast majority of members in both age groups had completed the vaccination course, any difference between the two groups had disappeared.

3 | EMPIRICAL STRATEGY

In what follows, we exploit differences in vaccination rates between age groups to assess the possible impact of vaccines on the MWTP. Specifically, we apply a DiD analysis using a continuous treatment

[13] A similar effect is observed in surveys of public opinion and fiscal policy conducted annually by CIS, a public entity charged with studying Spanish society. Indeed, the number of respondents over the age of 65 who reported themselves to be more willing to pay higher taxes to improve public services and social benefits was only greater than that of the rest of the adult population in 2021, and not in any other year. The 2021 survey was conducted at the end of July 2021 (CIS, 2021).

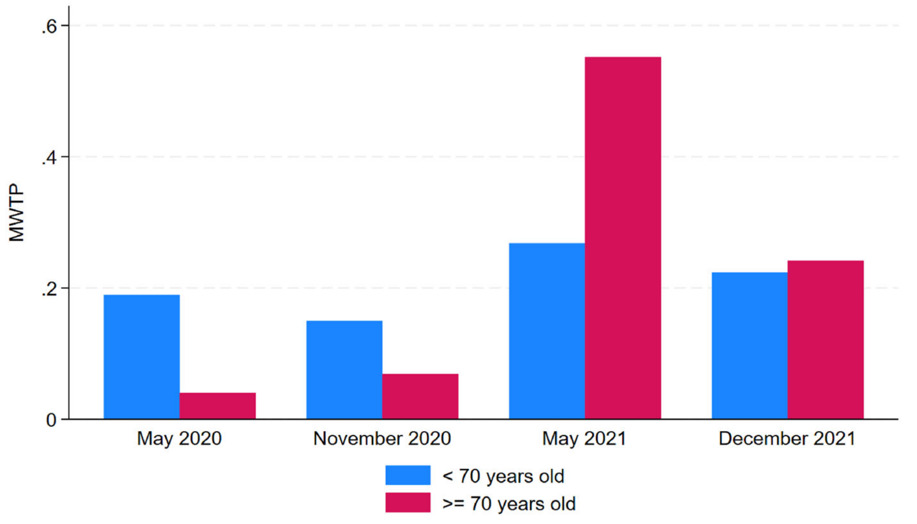

FIGURE 2 MWTP average values by survey wave and age (<70/≥70). *Note*: MWTP values: −1 (less taxes), 0 (status quo), +1 (willing to pay up to an additional 5 per cent of their annual income), +2 (between 6 and 10 per cent of their annual income) and +3 (more than 10 per cent of their annual income). *Source*: Netquest survey.
[Colour figure can be viewed at wileyonlinelibrary.com]

approach. In this respect, variation in treatment intensity makes it possible to evaluate treatments that lack untreated comparison units because all units are, to some extent, treated (Callaway, Goodman-Bacon and Sant'Anna, 2024). Here, our measure of treatment intensity is the variable Vaccination coverage, that is, the percentage of individuals who received the full COVID-19 vaccine course. We collect this percentage across different age groups and the Spanish regions during the third survey wave. Recall, in the first and second waves the vaccination programme had yet to be launched. By the fourth wave, vaccination coverage had become generalised across age groups with the result that our variable failed to capture any significant variation across individuals. Thus, being unable to distinguish between people more or less affected by the policy – a condition that is key for our identification strategy – we did not use the fourth wave in our estimation. Finally, because people's preferences can be notably affected by their age, we restrict our sample to groups of people of similar age and for whom vaccination coverage differed markedly. More specifically, we use data related to individuals aged between 60 and 79, where those in the 60–69 age group presented a vaccination coverage of 11 per cent and those in the 70–79 age group presented a coverage of 85.2 per cent. We then estimate the following model:

$$\mathrm{MWTP}_{ipty} = \alpha + \beta\,\text{Vaccination coverage}_{rty} + \mu X_{it} + \pi_p + \tau_t + \omega_y + \varepsilon_{ipty}. \tag{1}$$

Here, i is the individual indicator, p is the provincial indicator, r is the regional indicator, t is the time (wave) indicator and y is the age class indicator.[14] MWTP_{ipty} is the outcome variable that measures the marginal willingness to pay taxes, as we defined in Section 2. Vaccination coverage$_{rty}$ is the variable that measures the intensity of the treatment, which varies by time, region and age class. Vaccination coverage ranges from 0, in the absence of the vaccination (e.g. the first two waves for all age groups and regions when the vaccine had yet to be launched), to 1 if all the respondents in an age group had completed the full vaccination course. The coefficient of interest, β, is the DiD estimate of the impact of vaccination coverage on MWTP, and X_{it} is a vector of personal/individual variables. We control for the following variables: political ideology, education, woman, income, living in a rental

[14] The specific age class definition depended on the availability of vaccine coverage data. In our analysis, the age classes adopted are over 80, 70–79, 60–69, 50–59, 40–49, 30–39, 20–29 and 12–19.

house and having children.[15] To account for the impact of COVID-19 on MWTP, we also control for COVID-19 exposure within the last 30 days and COVID-19 exposure within 31–120 days. The former accounts for the number of deaths per 1,000 inhabitants in the province of residence of the individual surveyed within the last 30 days before the interview in each wave, while the latter is the number of provincial deaths per 1,000 inhabitants over the previous 31–120 days before the interview in each wave. To complete the description of equation (1), π_p are the provincial fixed effects, τ_t are the time (wave) fixed effects and ω_y are the age class fixed effects. The inclusion of the provincial, time and age class fixed effects enables us to control for province-specific, age-specific, time-invariant unobserved characteristics and common shocks. The error term ε_{ipty} is clustered at the provincial level.

The key identifying hypothesis for DiD estimates is that the variation in the MWTP of the control group is an unbiased estimate of the counterfactual. While we cannot directly test this hypothesis, we can check whether, in the absence of treatment, the difference between the treated group and the control group is constant over time. If the difference is constant over time, we can assume that, after treatment, a change in this difference, if any, is determined only by the effect of the COVID-19 vaccination campaign. An event study analysis can shed light on the plausibility of this assumption by testing whether there is no difference in pre-treatment trends of the control and treatment groups (i.e. the so-called parallel trends assumption). However, when all units in the sample receive the treatment, it is impossible to directly test the standard parallel trend assumption (Callaway et al., 2024). An alternative is to compare units that are more treated to units that are less treated in the event study. Following Acemoglu and Finkelstein (2008), we do this by building the leads of the intensity of the treatment variable 'Vaccination coverage'. Thus, we anticipate the vaccination campaign so that respondents in the first and second waves should be affected by it. Hence, we estimate the following event-study specification:

$$\mathrm{MWTP}_{ipty} = \alpha + \beta_1 \text{Vaccination coverage}_{ryt-2} + \beta_2 \text{Vaccination coverage}_{ryt} + \mu X_{it} + \pi_p + \tau_t + \omega_y + \varepsilon_{ipty}. \quad (2)$$

We consider Vaccination coverage$_{ryt-1}$ as the baseline and, therefore, we omit it from equation (2). This specification enables us to test the parallel trends assumption in the pre-treatment period; that is, whether the coefficient associated with the lead β_1 is not statistically different from zero.

To confirm the previous result, we perform a robustness test of the parallel trends assumption by using a dummy variable to capture the difference between more treated and less treated units. We identify the treatment group as those with a vaccine coverage higher than the median value, coinciding with individuals aged over 70 (treated). Hence, in this specification, the control group includes those under the age of 70. Thus, we estimate the following event-study specification:

$$\begin{aligned}\mathrm{MWTP}_{ipty} = {} & \alpha + \beta_1 \text{Vaccination campaign}_{irty} * \text{treated}_{iryt-2} \\ & + \beta_2 \text{Vaccination campaign}_{irty} * \text{treated}_{iryt} \\ & + \gamma \text{treated}_{iryt} + \mu X_{it} + \pi_p + \tau_t + \omega_y + \varepsilon_{ipty}. \end{aligned} \quad (3)$$

Here, treated$_{iryt}$ is a dummy variable equal to 1 if the respondent i is more than 70 years old, and 0 otherwise. Vaccination campaign$_{irty}$ is a dummy variable equal to 1 in the third wave. We consider Vaccination campaign$_{iryt}$ * treated$_{iryt-1}$ as the baseline and, therefore, we omit it from equation (3).

4 | RESULTS

4.1 | Main results

Table 3 reports the results obtained for the different specifications of equation (1). In column 1, we do not control for socio-economic variables; in column 2, we incorporate these variables; and in

[15] The summary statistics and the description of all variables are reported in Table A.1 in the online Appendix.

TABLE 3 DiD regressions with intensity measure of the treatment (COVID-19 vaccination coverage).

	MWTP (1)	MWTP (2)	MWTP (3)	MWTP Full sample (4)
Vaccination coverage	1.016***	1.044***	1.046***	0.525**
	(0.331)	(0.359)	(0.360)	(0.261)
COVID-19 exposure last 30 days			0.602	−0.319
			(1.328)	(0.492)
COVID-19 exposure 31–120 days			−0.792	−0.251*
			(0.629)	(0.150)
Political ideology		−0.002	−0.002	−0.002***
		(0.002)	(0.002)	(0.001)
Education		−0.009	−0.009	0.030*
		(0.051)	(0.051)	(0.017)
Woman		−0.145	−0.157	−0.023
		(0.137)	(0.149)	(0.064)
Income		0.019	0.020	0.006
		(0.052)	(0.051)	(0.011)
Lives in a rental house		0.210	0.256	−0.047
		(0.150)	(0.176)	(0.069)
With children		−0.103	−0.113	−0.226***
		(0.185)	(0.183)	(0.079)
Age		−0.012	−0.013	0.003
		(0.026)	(0.026)	(0.008)
Constant	−0.306	0.749	1.046***	0.373
	(0.114)	(1.956)	(0.360)	(1.244)
Observations	237	237	237	1,204
R^2	0.119	0.215	0.227	0.092
Province fixed effects	Yes	Yes	Yes	Yes
Wave fixed effects	Yes	Yes	Yes	Yes
Age class fixed effects	Yes	Yes	Yes	Yes

Note: OLS estimates. 'Vaccination coverage' is the number of individuals vaccinated divided by the population to be vaccinated, by age class and by region. Estimates in the first three columns use the subsample of 60–79 year olds. Column 4 uses the sample containing all age groups. Robust standard errors in parentheses, clustered at provincial level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

column 3, we account for the impact of exposure to COVID-19. The first three columns of Table 3 show a positive and statistically significant coefficient at the 1 per cent level of vaccination coverage on MWTP. The point estimates range from 1.016 to 1.046. We measure the impact of the vaccination on MWTP by using the average difference in vaccination coverage between the 70–79 age group and the 60–69 group (i.e. 73.5 percentage points). This difference implies an increase in MWTP of between 0.747 and 0.769. This impact is notable given that the average MWTP for the 70–79 and 60–69 age groups is 0.365. We test the validity of this result by expanding the sample through the progressive inclusion of all age groups as reported in the online Appendix (Figure A.1). The result holds for all age group intervals. In this regard, column 4 of Table 3 reports the outcome when the sample includes

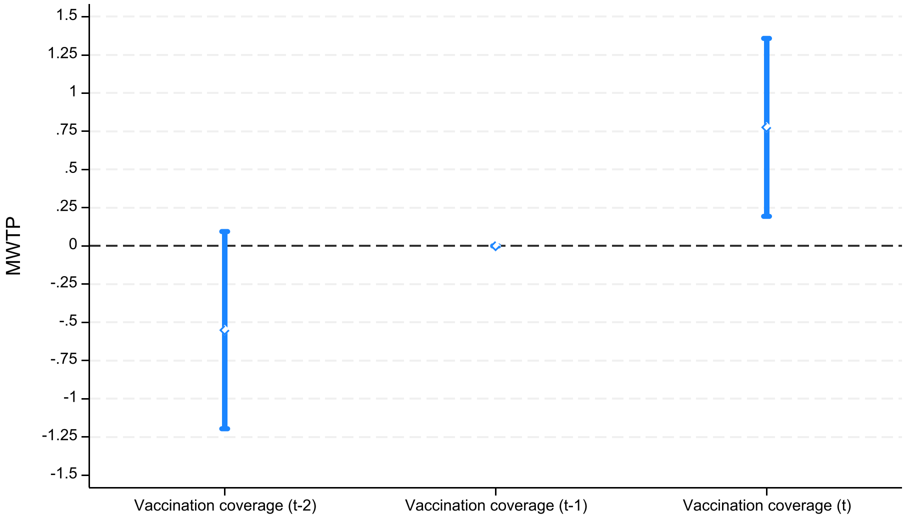

FIGURE 3 Event-study coefficients for the continuous treatment specification. *Note*: Point estimates, together with their 90 per cent confidence intervals, of the event-study specification (equation (3)). Estimates for the subsample of 60–79 year olds. The baseline period of the event study corresponds to the second wave ($t-1$).
[Colour figure can be viewed at wileyonlinelibrary.com]

all age groups (i.e. individuals from 18 to 87 years old). This last estimate presents a positive (0.525) and statistically significant coefficient at the 5 per cent level.[16]

By way of a robustness test, we apply a standard DiD by using a dummy variable 'Vaccination campaign' that is equal to 1 if the respondent is more than 70 years old (treated), and 0 otherwise (control). Under this setting, we find that the interaction between treated individuals and the dummy variable is statistically positive and significant across all specifications, with point estimates ranging from 0.476 to 0.766 (Table A.3).

The results of the event study shown in Table 4 (equation (2)) confirm the validity of our analysis: coefficient β_2 is positive and statistically significant at the 5 per cent level and the coefficient of the lead variable, β_1, is not statistically significant, further bolstering the validity of the common trend assumption (see also Figure 3). The results of the event study with the dummy treatment variable 'Vaccination campaign' (equation (3)) also support the validity of the common trend assumption (see Table 5 and Figure 4).

4.2 | Further robustness tests

Finally, we perform two additional robustness tests. In Table A.4, we employ fake vaccination coverage variables. Thus, we falsify the timing of the vaccination campaign as if it had been conducted before the second wave but after the first wave (column 1). In column 2, we employ an additional fake vaccination coverage variable, falsifying the timing of the vaccination campaign as if it had taken place before the first wave. In both regressions, we include all socio-economic controls and fixed effects. The estimate is not statistically significant in either case.

To address the potential limitations of the OLS estimation method when the dependent variable is a categorical variable, we estimate an ordered logistic regression (OLR). The main results are confirmed (Table A.5). Note that the average difference in vaccination coverage between the 70–79 age group (0.852) and the 60–69 group (0.117) equals 0.735. Using the estimated coefficient (2.592) in

[16] These results are confirmed by replacing the variable MWTP from −1 to +3 with the definition of MWTP from −1 to +1 (Table A.2).

TABLE 4 Event study estimates with continuous treatment variable (baseline: vaccination coverage $_{t-1}$).

	MWTP
	(1)
Vaccination coverage$_{t-2}$	−0.551
	(0.382)
Vaccination coverage$_t$	0.776**
	(0.345)
COVID-19 exposure last 30 days	0.306
	(1.351)
COVID-19 exposure 31–120 days	−0.743
	(0.642)
Political ideology	−0.002
	(0.002)
Education	−0.008
	(0.050)
Woman	−0.147
	(0.150)
Income	0.018
	(0.051)
Live in a rental house	0.231
	(0.184)
With children	−0.102
	(0.169)
Age	−0.013
	(0.027)
Constant	1.011
	(2.268)
Observations	237
R^2	0.220
Province fixed effects	Yes
Wave fixed effects	Yes
Age class fixed effects	Yes

Note: OLS estimates. 'Vaccination coverage' is the number of individuals vaccinated divided by the population to be vaccinated, by age class and by region. Estimates use the subsample of 60–79 year olds. Robust standard errors in parentheses, clustered at provincial level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

column 3, and multiplying by 0.735, the probability that a respondent expresses a willingness to pay higher taxes up to 5 per cent of their annual income increases by 0.132. The probability that a respondent indicates a willingness to pay higher taxes between 6 per cent and 10 per cent of their annual income increases by 0.196, and the probability that they reveal a willingness to pay more than 10 per cent of their annual income increases by 0.04.

TABLE 5 Event-study estimates with binary treatment variable.

	MWTP
	(1)
Treated × Vaccination campaign$_{t-2}$	−0.530
	(0.391)
Treated × Vaccination campaign$_t$	0.582**
	(0.234)
Treated	0.114
	(0.308)
COVID-19 exposure last 30 days	0.273
	(1.315)
COVID-19 exposure 31–120 days	−0.720
	(0.628)
Political ideology	−0.001
	(0.002)
Education	−0.010
	(0.050)
Woman	−0.148
	(0.151)
Income	0.018
	(0.052)
Live in a rental house	0.235
	(0.182)
With children	−0.108
	(0.168)
Age	−0.014
	(0.027)
Constant	0.975
	(2.000)
Observations	236
R^2	0.222
Province fixed effects	Yes
Wave fixed effects	Yes
Age class fixed effects	Yes

Note: OLS estimates. 'Treated' is a dummy variable equal to 1 if respondents are more than 70 years old, and 0 otherwise. 'Vaccination campaign' is a dummy variable equal to 1 only in the third wave. Estimates $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

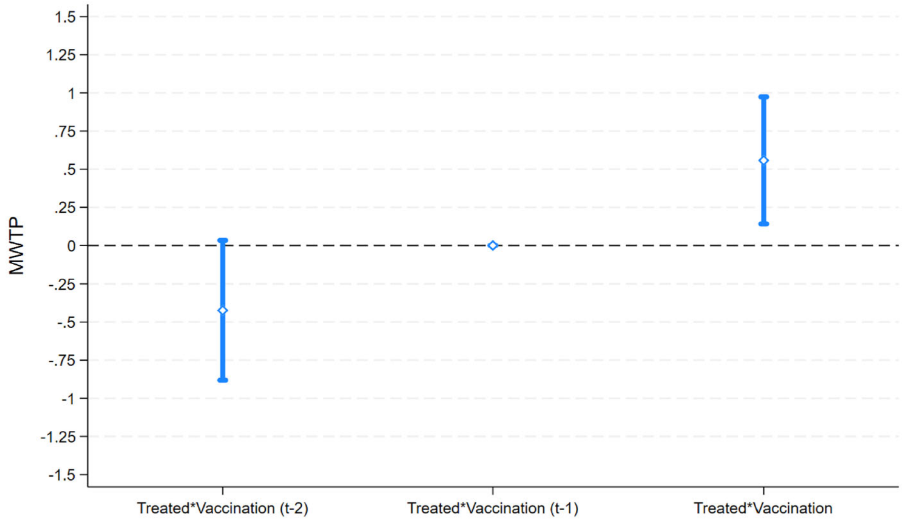

FIGURE 4 Event-study coefficients with binary treatment variable. *Note*: OLS estimates. Point estimates, together with their 90 per cent confidence intervals, of the event-study specification. 'Treated' is a dummy variable equal to 1 if respondents are more than 70 years old, and 0 otherwise. 'Vaccination' is a dummy variable equal to 1 only in the third wave. Estimates for the subsample of 60–79 year olds. The baseline period of the event study corresponds to the second wave (t−1).
[Colour figure can be viewed at wileyonlinelibrary.com]

5 | CONCLUSIONS

Paying taxes does not convey a direct benefit to taxpayers, but good governance can increase citizens' trust in the public sector and, in turn, lead to an increasing predisposition to contribute to the common good, that is, to a higher MWTP. The COVID-19 vaccination campaign can be regarded as a visible, successful response by the public authorities to a major health threat and this paper analyses whether this response had any impact on the MWTP in Spain.

Taking advantage of differences in the vaccination coverage across age groups, and using survey data and a DiD empirical strategy, complemented by an event study, enables us to infer causality running from the vaccination campaign to the MWTP. Indeed, we find an increase in the MWTP for individuals in age groups presenting a higher vaccination coverage at the time of the survey. As such, we contend that good governance of the COVID-19 vaccination roll-out caused an increase in the willingness to pay higher taxes.

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CONFLICT OF INTEREST STATEMENT

The authors certify that they have no affiliations with or involvement in any organisation or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this paper.

DATA AVAILABILITY STATEMENT

The survey data used for the empirical exercise are private but might be shared by the corresponding author for replication issues, upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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