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Rein in Pandemic by Pricing Vaccine: Does Social Trust Matter?

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Abstract

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Keywords: Social Trust; Vaccine efficacy; COVID-19; Outer-group trust; Willingness to Pay

JEL Code: I12; H23; H51; Z13; I18

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Declarations of Interest: None

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Rein in Pandemic by Pricing Vaccine: Does Social Trust Matter?

1. Introduction

Preservation of the human race has often been attributed to the remarkable quality of social cooperation (Heilbroner, 2011). Scholars across disciplines have identified evolution in people's ability to place trust in one another as the core component of social capital that drives such cooperation (Putnam, 1995; Inglehart, 1997; Fukuyama, 1995). In times of public health crises, can such trust protect public health? Using a theoretical framework and a primary survey from India, we ask if higher social trust can improve two aspects of paying for COVID-19 vaccines: people's likelihood (LTP) and their willingness to pay (WTP). The former allows us to look at the effects at the extensive margin and the latter at the intensive margin, respectively. In the process, we also assess this relationship of interest for vaccines with lower efficacy.

In the initial months of the pandemic when non-pharmaceutical interventions were the dominant public health response, higher social capital, including social trust, was associated with a decline in mobility and improved compliance with social distancing protocols (Barrios, et al., 2021; Müller & Rau, 2021; Borgonovi & Andrieu, 2020). However, rising economic and psycho-sociological burden posed constraints on sustainability of these measures (Goldstein, et al., 2021). Importantly, as scientific breakthroughs were made and vaccines became commercially available since early 2021, vaccination drives *en masse* became the mainstay of the global public health response. As vaccines lower the risk of contraction and spread of virus, they have both private and social benefits, thereby exhibiting characteristics of a public good.

In modern societies, specialization and globalization necessitate frequent interactions amongst strangers, resulting in the development of a generalized notion of trust. This has over the years gained prominence over specific trust, which involves interaction with a narrower circle of familiar people (Delhey, 2011). Evidence suggests that social trust is the basis of reciprocity, social cohesion, collective action (Helliwell & Putnam, 2004; Uslaner, 2002) and has also been described as the 'civic lubricant' for prosperous societies (Delhey, 2011). As higher social trust is associated with more concern for others, an individual's demand for vaccines can potentially increase because it reduces the possibility of passing on the infection to others. In this paper, we develop a theoretical basis for this argument and present empirical evidence from India on how such trust can influence the LTP and WTP for COVID-19 vaccines. Further, we examine the implications of higher vaccine efficacy on these marginal effects of social trust, which work through two channels. First, through a reduction in general risk of infection,

which enhances private incentive to pay more (private incentive channel). Second, through a reduction in the loss one can inflict on others through social interaction, which encourages free riding and paying less at the margin (free-riding channel). Which one of these two opposing channels dominates over the other is an empirical question.

As in most countries, COVID-19 cases in India were first reported from metropolitan cities, which were better integrated into the global supply chain network and had higher exposure to international travelers. By the end of March, 2020, as lockdowns and other containment measures brought economic activity to a standstill, a painful exodus of migrant workers to rural areas followed (Ratha, et al., 2020; Rathore & Khanna, 2021), which predicted the COVID-19 diffusion pattern (Lee, et al., 2021). As COVID-19 cases started to rise, a vital concern was that of infection spreading to rural areas, which are characterized by poor health infrastructure, paucity of testing services and surveillance systems (Kumar, et al., 2020). In this context, we focus on peri-urban areas, which emerge with increasing urbanization. These areas are rural as per the administrative division but find themselves on the expanding urban periphery. Residents here maintain strong economic ties with urban centres and rely upon them for employment and livelihood. This unique spatial and economic feature makes these areas vulnerable to infection. Moreover, as these areas serve as a buffer between urban and rural spaces, they are also strategically important in efforts to contain the spread of infection. In early 2021, we conducted a household survey in such settings for a hypothetical set of COVID-19 vaccines, one with 70% and the other with almost full efficacy. Among other things, we inquired about people's LTP and WTP for these vaccines. Importantly, this survey was conducted at a time when only the healthcare and other frontline workers were being inoculated and mass vaccination was yet to begin. Also, there was a general lack of clarity over how vaccines would be distributed and priced for the general public. In the survey, we also asked specific questions that were intended to measure social trust and elicit in-group (trust for people with whom one interacts frequently) and out-group trust (trust for somebody less familiar).

As predicted by our theoretical model, which is validated by the empirical results, we find that respondents with higher social trust report higher LTP and WTP for the vaccine with almost 100% efficacy, thereby exhibiting a significant effect at the extensive and intensive margin. On average, one standard deviation increase in social trust is associated with an increase of 13 percentage points (72 percent) in the LTP (WTP) for this vaccine variant. Using exogenous variation in out-group trust of neighbors of the respondent as instrumental variables (IV), we find the results remain positive and significant. For robustness check, we use different specifications and an alternate measure of WTP elicited through a choice experiment. We also test for coefficient stability under omitted variable bias

through bias adjusted treatment effects (Altonji, et al., 2005; Oster, 2019). Next, instead of fully exogenous, we consider the IV to be "plausibly exogenous" and obtain the relevant bounds for which the treatment effect remains strictly greater than zero. We also conduct the doubly robust Inverse Probability Weighting Regression Adjustment (IPWRA) and Lee bounds to estimate upper and lower bounds of these effects to account for any potential bias because of vaccine hesitancy.[1] We similarly find statistically significant and positive relationship between social trust and LTP and WTP for vaccine with lower efficacy (70%). Importantly however, these effects are significantly higher for the lower efficacy variant, which suggests that the free-riding channel dominates the private incentive channel in the present context.

The main contributions of this paper are as follows. First, we contribute to the literature on the importance of social trust during public health emergencies. Existing evidence highlights its effects on reducing mobility and improving compliance, which are important but difficult to sustain over time. We find that social trust is vital in promoting the LTP and WTP for COVID-19 vaccines, which has been the mainstay of the public health response and is likely to be the preferred option to tackle future pandemics. Second, our findings reveal that higher social trust counters lower efficacy of a vaccine variant by assigning a higher social value at the margin. This may be vital in scenarios where more effective vaccines need more time and resources to be developed and globally distributed.

The structure of the paper is as follows. Section 2 provides a theoretical basis that links generalized social trust and LTP for COVID-19 vaccines. Section 3 presents data and the identification strategy. Section 4 presents findings and tests for internal validity. Section 5 concludes.

2. Theoretical Framework

This section presents an analytical framework to illustrate the role of social trust on individuals' LTP for vaccine against a virus infection. Consider a society with a continuum of individuals susceptible to such infection. Individuals may get infected either exogenously or through social interaction. However, the risk of infection can be reduced through vaccination at a price. Everyone independently decides whether to get vaccinated by this price. Let $\theta_i \in \{0,\ 1\}$ denotes vaccination status, which is private information of individual i: $\theta_i = 1$ if individual i is vaccinated, and $\theta_i = 0$ otherwise. Let $v \in (0, 1]$ be the efficacy of the vaccine, which is common knowledge and does not vary across individuals. Since we focus on a representative individual, the subscript i will be dropped henceforth, but it is understood that θ varies across individuals and the average vaccination rate in the economy is $\bar{\theta}$.

[1] Overall vaccine hesitancy was low, and 97% and 90% respondents were keen to get vaccinated with the hypothetical variants of ~100% and 70% effective vaccines, respectively.

An individual with characteristic k (which can be related to health, family, nature of jobs or location) gets infected in two ways: either in course of necessary economic activities with probability $p(\theta v;\ \bar{\theta}, k)$ or in course of social interactions with probability q. We assume that the social circles are exogenously given, as is one's economic sphere of interactions.[2] The simplest way to model the intra-group risk of infection is to assume that q depends on the economy-wide average vaccination rate along with the efficacy of vaccination and the size of the group. Thus, we hypothesize $q = q(\bar{\theta}, S)$. Expectedly, $q(.)$ falls with $\bar{\theta}$, and rises with *S*. Next, with an assumption of random matching both at workplace and society we can write one's probability of getting infected as

$$\rho(\theta v;\ \bar{\theta}, k) = p(\theta v;\ \bar{\theta}, k) + \Big(1 - p(\theta v;\ \bar{\theta}, k)\Big)\, q(\bar{\theta}, S). \qquad (1)$$

Similarly, we define the probability of the same individual infecting other members of one's social group as

$$r(\theta v;\ \bar{\theta}) = \ \rho(\theta v;\ \bar{\theta}, k)[1 - q(\bar{\theta}, S)]. \qquad (2)$$

A natural restriction would be that $0 \leq p(v;\ \bar{\theta}) < p(0;\ \bar{\theta}) \leq 1$ and $p(.)$ is a strictly decreasing function in *v*. Being vaccinated as well as the efficacy of the vaccine reduce one's chance of catching infection. In addition, we assume that an individual cares about not passing the infection to others when he has some amount of social trust, which we denote by $\sigma(S)$, which may depend on the size of the group he interacts with.

Infection leads to illness, disutility and economic losses, which we combine into a loss function $L(\theta v, k)$ of the representative individual with vaccination status θ. The same individual imputes $\bar{L}(S) = L(\bar{\theta} v; S)$ as the cost he will inflict on fellow social group members if he infects them. Again, natural restrictions are $0 < L(v) < L(0)$, $0 < \bar{L}(v) < \bar{L}(0)$, and $L(.)$ and $\bar{L}(.)$ are strictly decreasing in vaccination status θ and the average vaccination rate $\bar{\theta}$, respectively.

Individuals are risk neutral and the utility of our representative individual from vaccination status θ is

$$u(\theta; \bar{\theta}, v, \sigma, k) = -\ \rho(\theta v; \bar{\theta}, k) L(\theta v, k) - \ \sigma(S)[r(\theta v; \bar{\theta}, k)\bar{L}(S)]. \qquad (3)$$

[2] An implicit assumption is that one's livelihood involves a large group of people, over which it is difficult to get individualized information. Of course, 'work from home' can be easily accommodated by setting *p*(.)=0.

Substituting $\theta = 1$ and $\theta = 0$ respectively we derive the utility levels of being vaccinated and not being vaccinated, from which we can calculate the gains from vaccination as $\Delta u(k) = u(v,k) - u(0,k)$. More explicitly, this expression becomes

$$\Delta u(v,k) = \rho(0,k)L(0,k) - \rho(v,k)L(v,k) + \sigma(S)[r(0,k) - r(v,k)]\bar{L}(S). \quad (4)$$

Since $\rho(0) > \rho(v)$ and $L(0) > L(v)$, gains from vaccination is always positive, even if for someone who is utterly selfish, i.e., $\sigma(S) = 0$, or someone who is a hermit (i.e., has no social group at all). An individual with characteristic k will be willing to pay for the vaccine of efficacy v, at most $\Delta u(v,k)$.

Let us also note that greater social trust will raise the WTP for the vaccine

$$\frac{\partial \Delta u(.)}{\partial \sigma} = [r(0,k) - r(v,k)]\bar{L}(S) = \left(1 - q(\bar{\theta}v, S)\right)^2 [p(0,k) - p(v,k)]\bar{L}(S) > 0. \quad (5)$$

Further the marginal effect of social trust on the WTP for vaccine varies with the vaccine efficacy in the following way:

$$\frac{\partial}{\partial v}\left[\frac{\partial \Delta u(.)}{\partial \sigma}\right] = \left(1 - q(\bar{\theta}, S)\right)^2 \left[-\frac{\partial p(v)}{\partial v}\bar{L}(S) + [(p(0) - p(v)]\frac{\partial \bar{L}}{\partial v}\bar{\theta}\right].$$

In the above expression the first term is positive while the second term is negative, making the overall sign ambiguous. Moreover, the negative term increases in the average vaccine rate of the economy. So, it is plausible that with very high vaccination rate the above marginal effect can be positive, which reflects free-riding incentive at the margin.

We can rewrite the above expression by making the following manipulations:

$$\frac{\partial}{\partial v}\left[\frac{\partial \Delta u(.)}{\partial \sigma}\right] = \left(1 - q(\bar{\theta}, S)\right)^2 \left[-\frac{\partial p(v)}{\partial v}\frac{v}{p}\bar{L}(S)\frac{p}{v} + \frac{\bar{L}}{v}[(p(0) - p(v)]\frac{v}{\bar{L}}\frac{\partial \bar{L}}{\partial v}\bar{\theta}\right]$$

$$= \left(1 - q(\bar{\theta}, S)\right)^2 \frac{\bar{L}p(v)}{v}\left[-\frac{\partial p(v)}{\partial v}\frac{v}{p} + \frac{[(p(0) - p(v)]}{p(v)}\bar{\theta}\,\frac{v}{\bar{L}}\frac{\partial \bar{L}}{\partial v}\right]$$

$$= \left(1 - q(\bar{\theta}, S)\right)^2 \frac{\bar{L}p(v)}{v}\left[-\eta_{p,v} + \delta(v)\bar{L}\,\eta_{\bar{L},v}\right],$$

where $\delta(v) = \frac{[(p(0) - p(v)]}{p(v)}$ is the relative attractiveness of the vaccine efficacy. The marginal effect of vaccine efficacy on the effect of social trust depends on two elasticity terms. $\eta_{p,v}$ is the elasticity of the

general infection probability with respect to vaccine efficacy and $\eta_{\bar{L},v}$ is the elasticity of others' loss with respect to vaccine efficacy. Both elasticity values are negative, but they work in opposite directions. The second effect is amplified by the magnitude of relative efficacy gain and the overall vaccination rate. If the second effect dominates, the effect of vaccine efficacy on the marginal impact of social trust will be negative. On the other hand, if the elasticity of others' loss is small and the first effect dominates then the effect of vaccine efficacy on the marginal effect of social trust will be positive.

In general, vaccine efficacy impacts on the marginal effect of social trust through two channels: one through a reduction in the general risk of infection, and the other through a reduction in the loss one can inflict on other people with whom the individual interacts socially. The first channel provides private incentive to pay more for the vaccine (private-incentive channel), while the second channel encourages to free ride and pay less at the margin (free-riding channel).

3. Data and Methodology

3.1 Sampling

To study the relationship of interest, we conducted a primary survey between January 31 to February 14, 2021. Given our focus on peri-urban areas for the reasons mentioned previously, we used a sampling strategy that had elements of both purposive and random selection. We purposively chose the capital district (Bhopal) in the state of Madhya Pradesh. During the first wave of COVID-19 infection, Madhya Pradesh reported a reproductive number (R_0) of 3.36, which was among the highest in India (Ghosh, et al., 2020). Historically, the state accounts for the majority share of outmigration in India (Das & Saha, 2013), and the increased reverse migration due to loss of livelihood translated to higher chances of infection spread.

Here, a mapping exercise was conducted to identify peri-urban areas (village councils) which met two qualifying criteria. These were, (a) village councils within 25 kilometres of the major railway station (Bhopal Junction) in the district and, (b) at-least half of the village households having someone working in Bhopal city before COVID-19 crisis, as reported by the elected village head. 11 villages across six village councils (clusters) satisfied these conditions and were all selected for the survey. Probability proportional to size (PPS) was used to randomly select 1,251 households across these 11 villages.[3]

3.2 Variables

[3] Details in Appendix Section-1.

We consider two hypothetical variants of COVID-19 vaccines, one with almost full efficacy and the other with 70% efficacy. For both, we posed question in an open-ended format to elicit WTP, where we asked "*Assume that a corona vaccine is available which can be effective for almost all individuals who are given the vaccine. What is the maximum amount you are willing to pay for each household member on average?"*. Next, we ask a similar question replacing "almost all" by "7 out of 10". In addition to these outcome variables, we also use modified double-bounded dichotomous choice contingent valuation method to ascertain WTP for robustness check. The open-ended questions have a continuous distribution, which can vary from [0, +∞] and, thus, provide the most efficient estimates (Boyle, 2003). Nevertheless, such open-ended questions may induce the respondents not to reveal their preferences honestly; thereby the responses might be biased. The use of self-reported certainty scales through the choice experiment can help in minimizing reporting bias, if any.[4] The questions used for the analysis are detailed out in the appendix section-3A.

To measure the level of generalized social trust (GST) we asked the following questions, which were based on our formative qualitative research (details available in Appendix section-3B): (i) "*suppose that someone from your immediate neighborhood faces a sudden crisis and needs your help. In your view, what is the likelihood of this person approaching you for help*?" (ST1); (ii) "*suppose two of your neighbors have a quarrel over something trivial. How likely is it that you would try to mediate and settle the matter?*" (ST2); (iii) "*think of one of your friends with whom you have not met in the last one to two years. If that friend needs some important financial help that would reduce your monthly spending, how likely is it for you to help that person?*" (ST3); (iv) "*suppose you befriend someone like you some months back. How likely would you be willing to informally lend a small sum of money to him/ her for something which is not very urgent?"* (ST4). To generate an aggregate measure of GST, we first normalize these four indicators, sum them up and then again normalize it (Heath and Tan, 2019).

This set of questions that elicit social trust also allows us to distinguish between two separate groups of trust. The first is the trust in a narrow circle of others who are familiar or known personally and the second is the wider circle of less familiar or unfamiliar others. Delhey (2011) broadly categories the former, which is functional in small communities where people interact with each other, as in-group trust. The latter is called the out-group trust where interaction happens between people who are not acquainted or familiar with each other. ST1 and ST2 above are related to immediate neighbors and hence we club them into in-group trust. ST3 and ST4 are both related to friends and acquaintances, thus clubbed into

[4] The use of this method has been outlined in recent WTP literature (Alemu et al. 2021; Das et al. 2021).

out-group trust. Using ST1 and ST2 we develop measures for in-group trust while ST3 and ST4 are used to create measures for out-group trust, both following Heath and Tan (2019).

In the survey, we also collect information on time-preference, social responsibility, trust in government, COVID-19 risk perception, beliefs and knowledge, compliance with social distancing protocols, socio-economic and demographic background, mobility, and the degree of economic shock experienced because of the pandemic.[5] The definition of the variables used in the analysis is provided in appendix table-T1 and the descriptive statistics of the analytical sample in Appendix table-T2.

3.3 Empirical Specification

We first estimate the following regression specifications for both types of vaccines:

$$Y_{ic} = \alpha + \beta . GST_{ic} + \sigma . X_{ic} + \pi_c + \varepsilon_{ic} \qquad (1)$$

Here Y_{ic} is the LTP and WTP (after inverse hyperbolic sine transformation) for vaccine for respondent, i, located in village council, c, derived from the open-ended question that we posed. LTP variable, which measures the extensive margin, takes the value of 1 if the respondent quotes an amount greater than zero and 0 if she is unwilling to pay any amount. For estimating the WTP (intensive margin), we apply the inverse hyperbolic sine transformation which allows us to include respondents reporting zero (Burbidge et al. 1988). GST_i is the measure of generalized social trust calculated by normalized summation of the individual indicators as defined in section 3.2. X_i is the vector of individual and household level covariates that we incorporate in the regression. Appendix table-T1 details out these covariates. We further control for village council level fixed effects through π_c and ε_i is the error term. We start with the vaccine with 100% efficacy to assess whether higher social trust is associated with its LTP and WTP. For robustness check, we also study the relationship of interest using the hypothetical vaccine with lower (70%) efficacy.

To account for the concerns surrounding unobserved heterogeneity we use the exogenous variation in the outer radius trust (ST3 and ST4) of neighbors (survey participants) residing within the cluster of 500 metres of the respondent household. As mentioned earlier, for out-group trust, we consider ST3 and ST4, which are related to friends and acquaintances and capture trust on distant non-neighbors. In simple words, if A and B are neighbors, in-group trust of B (which depends on A) can influence trust of A, as well as her LTP and WTP in multiple ways. However, the out-group trust of B, which is not

[5] Questionnaire available in Appendix Section-2.

dependent on A, is unlikely to have a direct influence on the outcome variables of A. The only way it can influence A's LTP and WTP is exclusively via A's measure of generalized trust. This variable is used as an IV to generate unbiased treatment effects using Two Stage Least Squares (2SLS) regressions.

4. Results

4.1 Effects on the extensive and intensive margin

In table-1, we present the marginal effects from the LPM regression (equation-1) to gauge the effects on LTP for vaccines with almost 100% efficacy. We estimate the regression with three specifications. The first one is without controls (column-1). In the second one, we control for the individual and household level economic and demographic characteristics, including the frequency of going outside for work and usage of public transport (column-2). The final, preferred specification includes the standardized score on trust in government and adherence of the pandemic related compliance protocols as explained in section 3.2 (column-3). The findings indicate that individuals with higher levels of social trust are more likely to pay for the vaccine. We observe an increase of about 13 percentage points associated with one standard deviation rise in the GST, on average. The effects are robust across all specifications and statistically significant at 1 percent level.

Table 1: Association of social trust with LTP and WTP for vaccines

		LTP			**WTP**		**WTP (Tobit)**	**Choice Experiment**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Social Trust	0.156***	0.138***	0.129***	0.967***	0.754***	0.720***	0.871***	0.058***
	(0.011)	(0.012)	(0.012)	(0.059)	(0.062)	(0.066)	(0.082)	(0.014)
Individual and household controls	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Trust with government	No	No	Yes	No	No	Yes	Yes	Yes
COVID-19 norm compliance	No	No	Yes	No	No	Yes	Yes	Yes
Village fixed effects	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Observations	1,219	1,219	1,219	1,219	1,219	1,219	1,219	1,219
Pseudo R^2	0.192	0.285	0.289	0.214	0.342	0.349	0.098	0.230

Note: Marginal effects from OLS regressions are presented with robust standard errors. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Next, we present the estimates from OLS regression to assess if individuals with higher GST have higher WTP for the vaccine. Here as well, we estimate three models with the same specifications as before

(columns 4-6 respectively). We find a statistically significant association between an individual's GST and her WTP for the vaccine. For one standard deviation increase in GST, the WTP increases by about 72 percent on average. We also use a tobit model to estimate the WTP using censored data of those, who reported of paying a non-zero amount for the vaccines. The findings remain quantitatively similar (column-7).

Using the choice experiment framework to elicit the WTP, we also run regressions to estimate how trust is associated with the WTP of Rs. 200 or more. We fix this threshold to avoid skewed distribution as 72% of the respondents reported that their WTP for the 100% efficacy vaccine is less than Rs. 200. Importantly, the WTP from the open-ended question is found to be Rs. 141, which matches with the modal response from the choice experiment. Column-8 of table-1 presents the marginal effects from the choice experiment with all the controls used in columns 3 and 6. We observe no change in the findings. On average, one standard deviation increase in GST is associated with close to 6 percentage points increase in the LTP INR 200 or more for the vaccine with ~100% efficacy.

For robustness check, we use Oster's (2019) method to account for omitted variable bias, to estimate parameter δ for which the association between GST and LTP turn statistically indistinguishable from zero (Appendix section-4, Appendix table-T3). The estimated δ value is 1.3, which is well beyond the value of one and indicates that the influence of potential unobservables would have to be 1.3 times that of all the control variables in our model to ensure that the null hypotheses are not rejected (Oster, 2019). A similar exercise for the WTP estimates δ of 1.36. Also, parameter δ for the LTP INR 200 or above is over 1.4, thereby corroborating the inference we draw. With the comprehensive set of control variables that we have used, this is unlikely to be the case. Therefore, even if we could account for the unobserved heterogeneity that may potentially confound our estimates, we are still able to reject the null hypotheses of no overall effects of GST.[6]

4.2 Effects using IVs

For more conclusive evidence on the relationship of interest, we use variation in the outer radius of trust of neighbors as IVs. We argue that neighbor's outer circle trust can only influence respondent's LTP or WTP for vaccines via the exclusive channel of respondent's GST. We check this empirically by regressing these outcomes on the main variable of interests, the IVs and the set of covariates. The

[6] Multiple empirical studies have used this method to obtain the bias adjusted treatment effects (Mukhopadhyay and Sahoo, 2016; Rathore and Das, 2021)

coefficients associated with both the IVs are found to be statistically insignificant at 10% level, indicating that the IVs and LTP/ WTP are not related once respondent's GST and other covariates are controlled for.

The estimates from the 2SLS regressions on the extensive and intensive margin are presented in table-2. Please note that we cluster the standard errors at the 500m cluster corresponding to every household since that is the level at which the IVs are defined. The findings confirm what we inferred from the naïve regressions: greater social trust led to a significantly higher LTP and WTP for the vaccine. In terms of the effect size, we find that one standard deviation increase in social trust raises the LTP by more than 25 percentage points. Notably, when compared with naïve regression, we find a substantial increase in the effect size when accounted for the unobserved heterogeneity, which suggests that the naïve regressions had underestimated the impact of GST on LTP. We draw the same inference for the WTP as well. For robustness check, instead of the two measures of outer trust that are taken together as IVs, we re-estimate the results by taking each of these variables one at a time and get similar results (table-2). Importantly, the results from running the 2SLS regression of LTP INR 200 or more, as elicited from the choice experiment, are also qualitatively similar (table-2).

Table 2: Two-stage least squares regression

	LTP			**WTP**			**Choice Experiment**		
	IV: ST3 and ST4	IV: ST3	IV: ST4	IV: ST3 and ST4	IV: ST3	IV: ST4	IV: ST3 and ST4	IV: ST3	IV: ST4
Social Trust	0.255***	0.180**	0.343**	1.614***	1.489***	1.678**	0.314**	0.433***	0.135
	(0.096)	(0.085)	(0.144)	(0.549)	(0.501)	(0.776)	(0.127)	(0.134)	(0.158)
Individual and households controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trust with government	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COVID-19 norm compliance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald F-statistics	23.11	19.57	11.84	23.11	19.57	11.84	23.11	19.57	11.84
Observations	1,133	1,111	1,111	1,133	1,111	1,111	1,133	1,111	1,111
Pseudo R^2	0.222	0.294	0.077	0.241	0.273	0.225	0.010	-0.242	0.209

Note: Marginal effects from 2SLS regressions are presented with standard errors clustered at the 500m cluster. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Further, following Azar et al. (2021) and considering the IVs to be "plausibly exogenous", we estimate the bounds for the effect of GST and find that the gains from social trust remains positive, even

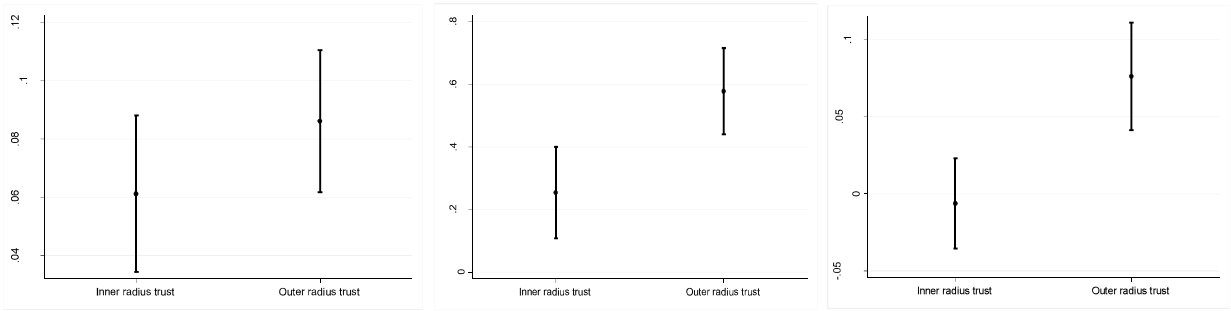
if the direct effect of the IV is up to 32%-44% of the reduced form effect (Appendix Section 5, table-T4). In other words, the IVs have to be highly endogenous to reduce the impact of trust on the outcome variables to zero, which is unlikely given the context we are studying.

We run an array of robustness checks to confirm the internal validity of our results. First, instead of using robust standard errors, we cluster the standard errors at the 500 m cluster, as has been done for the IV regressions. Second, instead of standardized scores, we use Principal Component Analysis (PCA) to create an index of social trust and use it as our main independent variable. Third, we create a dichotomous variable dividing responding into two categories based on standardized GST, classified as low trust (median value or below) and high trust (above median values) (See Appendix Table-T5). Fourth, we include each of the four variables on trust separately in the model (Appendix Figures F1 to F3). Fifth, we also use the Inverse Probability Weighting Regression Adjustment (IPWRA) to estimate the unbiased treatment effect of social trust. Conceptually, IPWRA first estimates the probability of an individual having higher trust and then assigns the inverse of these weights while running the regression. In all these cases, we find the respondents with higher GST have significantly higher LTP and WTP for the vaccine. Further, in these regressions, we drop respondents, who are hesitant to take vaccine. The non-inclusion of these respondents may result in potential non-random attrition bias. To account for this bias, we use Lee bounds to estimate the effects with adjusted upper and lower bounds (Lee, 2009) and find both to be significantly higher than zero, thereby providing evidence for a clear relationship between GST and LTP and WTP (Appendix Table-T3). Together, these findings provide credible evidence of a positive causal relationship between respondent's GST and their LTP and WTP for vaccines.

4.3 Is outer radius trust more influential?

To assess if social benefits of vaccination plays a significant role in this overall relationship, we further examine how each of the four individual variables that measure GST are associated with the LTP and WTP for the ~100% effective vaccine, after accounting for the other three. Here, in the same model, we include the aggregate in-group and out-group trust measure together in the regressions. Although the secular effect of both these measures is important for paying for COVID-19 vaccines, the effect size of out-group trust appears to be higher (Figure-1). This implies even after controlling for the in-group trust measures, those who would readily help out-group members report disproportionately higher LTP and WTP for vaccine. This additionally demonstrates the significant influence of social trust in motivating people to take up COVID-19 vaccination.

Figure-1: Association of inner and outer radius trust with LTP and WTP



Note: Marginal effects from OLS regressions are presented with 95% confidence interval calculated from robust standard errors.

4.4 What are the implications on the vaccine with 70% efficacy?

In comparison to the almost fully effective vaccine, the effects of GST on LTP and WTP for vaccines with lower efficacy might go in either direction. This depends on the relative importance of potentially higher losses one can inflict on others through infection transmission vis-à-vis higher general risk of self-infection due to reduced vaccine efficacy (see section-2). In this setting, we hypothesize that, due to the decrease in vaccine efficacy, the loss one can inflict on others through social interaction increases disproportionately compared to associated decrease in private incentive to pay for a vaccine variant with a higher general risk of infection. This should then result in higher marginal effects of GST on LTP and WTP for vaccine having lower efficacy. We test this hypothesis by estimating the same models as before but for a hypothetical vaccine with 70% efficacy. Table 3 presents the estimates for naïve as well as 2SLS regressions using the same IVs as earlier. As seen for the ~100% effective variant, we find a positive effect of GST on the LTP and WTP, which underscores the importance of the public good character of a vaccine. Importantly, we observe an increase in the marginal effects when compared to the almost fully effective vaccine. While one standard deviation rise in GST, on average, increases the LTP (WTP) for a ~100% effective vaccine by 13 percentage points (72 percent), for the vaccine with 70% efficacy, this effect is 15 percentage points (80 percent) for the naïve regressions (table 3). This difference is statistically significant at 5% level, which remains robust across the 2SLS estimates. Though estimations from the choice experiment regressions yield a lower WTP for the vaccine with ~70% efficacy, the difference is not found to be statistically significant. We note that the average WTP is INR 116 for the 70% efficacy vaccine which is lower than ~100% effective variant (INR. 141). This is expected as individuals are likely to place a higher weightage on private protection against the virus. However, what is suggestively evident is that the marginal effects of GST on LTP and WTP are higher for the vaccine having lower efficacy. We argue that this is potentially driven by lower free riding due to higher chances

of infecting others. More research is needed to produce robust evidence on how GST interacts with vaccine variants of different efficacy and the exact mechanisms behind this relationship.

Table-3: Effects on the vaccine with 70% efficacy

	LTP		WTP		Choice experiment	
	LPM	2SLS	OLS	2SLS	LPM	2SLS
Social Trust	0.148***	0.263***	0.800***	1.712***	0.050***	0.361***
	(0.012)	(0.092)	(0.066)	(0.493)	(0.013)	(0.116)
Individual and household controls	No	Yes	Yes	No	Yes	Yes
Trust with government	Yes	Yes	Yes	Yes	Yes	Yes
COVID-19 norm compliance	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	No	Yes	Yes	No	Yes	Yes
Wald F-statistics		22.16		22.16		22.16
Observations	1,128	1,052	1,128	1,052	1,128	1,054
Pseudo R^2	0.321	0.270	0.402	0.285	0.204	0.084

Note: Marginal effects from OLS and 2SLS regressions are presented with robust standard errors and standard errors cluster at the 500m cluster in parenthesis. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

5. Conclusion and Discussion

Over the course of our history, social cooperation has shaped the resilience and progress of humanity. This has again been challenged by the COVID-19 pandemic. Vaccinations during such crises can prevent the spread of the infection and reduce severe illness and deaths. In this context, WTP for vaccines captures the value individuals place, both on self-preservation (private benefits) and on breaking the chain of infection transmission (social benefits). This paper develops a theoretical model to study the implications of GST on the LTP and WTP for vaccines and tests its validity using survey data from peri-urban areas of India. Our findings provide credible evidence of higher GST being causally linked with significantly higher LTP and WTP for different efficacy variants of COVID-19 vaccines. Importantly, when efficacy of the vaccine falls, we also find an associated increase in the marginal effects of GST on LTP and WTP. Thus, with a higher chance of infecting others when using a lower efficacy vaccine, an individual with higher GST is less likely to free ride and pay more at the margin.

These findings have significant policy implications. It emphasizes the role of social trust in amplifying resilience in the face of public health emergencies. The higher value attached to a vaccine when prevailing social trust is high highlights the public good character of vaccines. This also reflects the importance of preservation and promotion of social trust in communities. During public health emergencies, the prevailing level of social trust may also be used as a diagnostic tool to identify

potentially vulnerable areas that need to be prioritized as part of the public policy response. Importantly, our findings emphasize the importance of social trust in countering lower efficacy of a vaccine variant by assigning a higher social value to it at the margin. Additionally, considering the different vaccines used by different countries, the findings suggest the relatively higher importance of social trust in developing countries like India, where a vast majority of residents were vaccinated using AstraZeneca (average efficacy of first dose about 70%) as against more developed countries like the United States of America, where Pfizer-BioNTech and Moderna were preferred for mass vaccination (average efficacy of 82% to 85%). Importantly, existing literature shows deteriorating levels of interpersonal trust across the globe (Bardhan, 2022), which can weaken community level safeguards against future public health crises. This is a vital theme for further research.

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Appendix Section-1: Additional details on sampling

Administratively, village councils in rural India have democratically elected local governments where the elected representative is chosen for a period of 5 years, as per the 73rd Amendment to the Indian Constitution. The six village councils were chosen from the administrative blocks of Phanda and Berasia of Bhopal district, as these lie on the periphery of Bhopal city.

To arrive at an appropriate sample size for the study, we relied on secondary evidence for parameters like the intra-cluster correlation (ICC). Previous studies in these setting suggest ICC of about 0.17. We chose a conservative value of about 0.20 for ICC and used the Ministry of Health's cost of procurement of COVISHIELD vaccine, which stood at about Rs 400 for the double dose.[1] Power was chosen to be 0.80. Based on these parameters, we calculated a required sample size of 1200 households, which was sufficient to detect a difference in means of about 0.08 standard deviation units. Ultimately, we ended up interviewing 1251 households, a figure that is about 4% higher than what our sample size calculations suggest. We note that in the data, ICC comes out to be 0.05 and is significantly lower than the benchmark used, which further improves the precision of our estimates. 3 out 1251 households refused to participate in the study and were replaced by their neighbours. The respondent of the survey was the household head. In case he/she was not available on three repeated visits, we interviewed the person in the household who was next in terms of financial decision making in the household.

[1] https://www.livemint.com/news/india/at-what-cost-is-govt-sourcing-serum-s-covishield-bharat-biotech-s-covaxin-explained-11610450615485.html (last accessed May 19th, 2022)

Appendix Section-2: Questionnaire

A. Social Trust

A1. *Think of one of your friends with whom you have not met in the last two years. If that friend needs some important financial help that would reduce your monthly spending, how likely is it for you to help that person?*

1= No chance of helping
2= low chance of helping
3= Neither high nor low chance of helping
4=High chance of helping
5=Will surely help

A2. Suppose two of your neighbours have a quarrel over something trivial. How likely is it that you would try to mediate and settle the matter?)

1= I would surely not try
2= There is a small chance I would try
3=Neither high nor low chance of trying
4= There is a high chance of trying
5= I will surely try

A3. *Suppose you befriend someone like you some months back. How likely would you be willing to informally lend a small sum of money to him/ her for something which is not very urgent?*

1=No chance of lending
2= low chance of lending
3= high nor low chance of lending
4= High chance of lending
5= Will surely lend

A4. *Suppose that someone from your immediate neighbourhood faces a sudden crisis and needs your help. In your view, what is the likelihood of this person approaching you for help?*)

1= No chance

2=low chance
3= Neither high nor low chance
4= High chance
5=Will surely approach

B.*Time preference*

B1. Suppose that you are considering purchase of an asset which can be sold at Rs 5,000 in 1 year. What is the maximum amount that you will be willing to pay to purchase this asset today?)

C. Fare Evasion, bribe

C1. Some people in your community may think paying bribe is acceptable, some may think it is not acceptable. Suppose you need to get some important official work done (get an affidavit/DL or Passport renewed etc) for which the officer asks for money. How likely is it that you would pay this amount?

1= No chance
2= low chance
3= Neither high nor low chance
4=High chance
5=Will surely pay

C2. Out of ten people in your community, how many do you think pay bribes to get their work done?

C3. Out of ten people in your community, how many do you think approve of paying bribes to get their work done?

D. Relative Economic Status

D1. In your locality, out of 10 households, how many you think are richer than your family?

E. ***Trust in government process***

E1. Are you satisfied with the following government services?)

(Options: 1=Very dissatisfied, 2= Somewhat dissatisfied, 3= Neither satisfied nor dissatisfied, 4= Somewhat satisfied, 5= Very satisfied

a. Ensuring food to the poor
b. Ensuring employment for the youth
c. Ensuring good schools for the children
d. Ensuring good government hospitals
e. Safety gears for doctors and nurses
f. Treatment of COVID-19 patients

F. Risk Perception of Corona

F1. Suppose that you are considering whether to go out for a function in your community where many different types of people will be present. Some of these people will follow social distancing measures like wearing masks etc but some will not. How likely is it that you participate in this function?

1= No chance of participation
2=Small chance of participation
3=Neither high nor low chance of participation
4=High chance of participation
5=Will surely participate

G. Knowledge about vaccine

G1. Are you aware of any government announcements about corona vaccine?

1= *Yes*

0= *No*→ skip to G2.

G1a..If yes, what did you hear?

Government Announcements	If heard about	
	Yes	*No*
• Free vaccine	1	0
• Subsidized vaccine	1	0
• Vaccine till now is not effective	1	0
• Vaccine is bad for health/side effects	1	0
• Availability of vaccine will take time	1	0
• Vaccine registration/application	1	0

G2. If the vaccine is available, what percentage/share of its price do you think that government will pay on your behalf to get you access to the vaccine?

1= Free (the government would pay entirely)
2= I will have to pay the entire amount
3=Half
4=A small part (Less than 50%)
5=A major part (More than 50%)

G3 *Assume that a corona vaccine is available which can be effective for almost all individuals who are given the vaccine. What is the maximum amount you are willing to pay for each household member on average (in Rs.)*

G4. *Assume that a corona vaccine is available which can be effective for 7 out of 10 individuals who are given the vaccine what is the maximum amount you are willing to pay for each household member on average (in Rs.)*

H. **Contextual COVID-19 Part)**

H1. How frequently did you do the following in the last month?
[Options: 1= Very frequently, 2= Frequently, 3= Neither frequently not rarely, 4= Rarely, 5= None of the time]

Activities	***Option (From above)***
I maintained at least 6 feet/ two meters in public	
I used a hand sanitizer when I am out	
I used a mask when I went out	
Avoided large crowd	

***I.* <u>COVID-19 testing</u>**

I1. *Imagine that you experience COVID-19 symptoms, how likely is it that you would contact your doctor/public health department?*

1 = No chance
2 =low chance
3 =Neither high nor low chance
4 =High chance
5 =Will surely contact/get in touch

***J.* Case of COVID-19**

J1. *Do you know any case of corona infection in your circle?*

1=*Yes*
0=*No*) ⟶ *SKIP TO J2*

J1a. *If 'Yes', Who?* (*Multiple Answers Possible*)

1= Family/members in the household
2= Relatives
3= Neighbours
4= Friends / Colleagues

J2. *Do you know any corona deaths in your circle?*

1=*Yes*
2=*No* ⟶ *SKIP TO J3*

J2a. *If 'Yes',Who?* (*Multiple Answers Possible*)

1= Family/members in the household
2= Relatives
3= Neighbours
4= Friends / Colleagues

J3. *How likely is it that you will get infected by COVID-19 within the next two months?*

1 = No chance
2 = low chance
3 = Neither high nor low chance
4 = High chance
5 = Will surely contact/get in touch

J4. *How likely is it that your family or close relative will get infected by COVID-19 in the next two months?*

1 = No chance
2 = low chance
3 = Neither high nor low chance

4 = High chance
5 = Will surely contact/get in touch

***K.* Monetary Cost of COVID19**

K1. As compared to last year, do you think that your family income has reduced due to corona?

1=*Yes*
0=*No (SKIP TO K3)*

K2. If yes, how much has it reduced per month approximately as a share/percentage of your monthly household income

K3. Do you think that your family income will reduce due to corona in the next one year as compared to today?

1= *Yes*
0= *No →SKIP TO section L.*

K4. If yes, approximately how much do you think it will reduce per month approximately as a share/percentage of your monthly household income as compared to today

L. Willingness to Accept COVID19 Vaccine

L1. *Will you be willing to accept a vaccine with full effectiveness?*

1= *Yes*
0= *No*

L2. *Will you be willing to accept a vaccine with 70% effectiveness (7 out of 10 get cured)*

1= *Yes*
0= *No*

***M.* COVID Vaccine**

M1. Suppose that when vaccines become available, it is priced at Rs 3000 per person (not necessary that this actually happens). Will you be willing to pay Rs. 3000 per person in your household for corona vaccine which is effective for almost each individuals who are given the vaccine?

1=*Yes*
2= *No* (*SKIP TO M1b)*

M1a. If 'Yes',How much?

1= Rs. 3500?
2= Rs. 4000?
3= Rs. 4500?
4= Rs. 5000?
5= Rs. 5500?
6= Rs. 6000?
7= Above Rs. 6000?

M1b. If 'NO', How much?

1= Rs. 2500?
2= Rs. 2000?
3= Rs. 1500?
4= Rs. 1000?
5= Rs. 500?
6= Rs. 300?
7= Rs. 200?
8. Less than Rs. 200

M2. Suppose I were to ask you the same question one week from now, how likely is it that your answer to this above question will remain the same?

1 = Small chance
2 = High chance

M3. Suppose that when vaccines become available, it is priced at Rs 3000 per person (not necessary that this actually happens). Will you be willing to pay Rs. 3000 per person in your household for corona vaccine which is effective for 7 out of 10 individuals who are given the vaccine?

1= हाँ (*Yes*)
0= नहीं (*No*) ⟶ *SKIP TO M3b*

M3a. If 'Yes',How much?

1= Rs. 3500?
2= Rs. 4000?
3= Rs. 4500?
4= Rs. 5000?
5= Rs. 5500?
6= Rs. 6000?
7= Above Rs. 6000?

M3b. If 'NO', How much?

1= Rs. 2500?
2= Rs. 2000?
3= Rs. 1500?
4= Rs. 1000?
5= Rs. 500?
6= Rs. 300?
7= Rs. 200?
8= Less than Rs. 200

M4. Suppose I were to ask you the same question one week from now, how likely is it that your answer to this above question will remain the same?)

1 = Small chance
2 = High chance

M5. Are you aware of names of vaccine/companies whose vaccines are being planned to be provided to Indian citizens? (Yes=1/No=2: Skip to next section(II))

M6. If yes above, could you tell us names of vaccines/companies that you know of who are making these vaccines (multiple options allowed, but do not mention names, let the respondent mention:

1= Oxford Covid-19 vaccine (same as Covishield or vaccine manufactured by Serum Institute of India (SII) 2=COVAXIN (same as vaccine by Bharat Biotech)
3= Pfizer/BioNTech
4= Moderna
5=Sinovac
6= Sinopharm
7= AstraZeneca
8=Others (Mention)

M7. Are you aware of the approximate price that someone like you will have to pay for the vaccine mentioned above? (Yes=1, No=2. If No, move to next section-II)

M8. If yes, above, what is this price per person (In Rs.)?

II. Social and economic characteristics (Let the head/his her spouse be the main respondent)

	Answer
A. State: codes, pre-loaded	
B. District	
C. Gender of respondent	1= Male 2=Female
D. Age (in Complete years)	_____ (Years)
E. Relationship to head	1= Head 2= Spouse of head
F. No. of HH permanent members	_____
G. No. of elderly (>60 years) in HH)	_____

H. No. of children <5 years in HH)	_____
I. No. of earning members in the HH	_____

J. No. of members with any of the following conditions in the HH: asthma (other lung related ailments), heart condition, diabetes, hypertension, members who recently had any surgeries since the beginning of 2020, Liver ailments.

Ailments	Number of members in household
a. Asthma (Other Lung related ailments)	_____
b. Heart Diseases	_____
c. Diabetes	_____
d. Hypertension / High BP	_____
e. Liver ailments	_____
f. Operation/Surgery from January 1 to date of survey	_____

K. Has ANY member been identified with any chronic ailment that needed hospitalization for more than 1 day since the beginning of 2020?

1 = *Yes*
0 = *No*

L. Your level of education

0= Illiterate, literate through informal sources, below class 1
1= Completed class 1
2= Completed class 2
3= Completed class 3
4= Completed class 4
5= Completed class 5
6= Completed class 6

7= Completed class 7
8= Completed class 8
9= Completed class 9
10= Completed class 10
11= Completed class 11 / diploma after class 10
12= Completed class 12
13= 1-year diploma after class 12
14= 2-years diploma after class 12
15= BA/BSC/Fazil
16= Diploma after BA/BSC
17= MA/MSC/Kamil & above
***18=** Hafezia/Kiratia/Nurani madrasa*

M. Highest level of education in your household

0= Illiterate, literate through informal sources, below class 1
1= Completed class 1
2= Completed class 2
3= Completed class 3
4= Completed class 4
5= Completed class 5
6= Completed class 6
7= Completed class 7
8= Completed class 8
9= Completed class 9
10= Completed class 10
11= Completed class 11 / diploma after class 10
12= Completed class 12
13= 1-year diploma after class 12
14= 2-years diploma after class 12
15= BA/BSC/Fazil

16= Diploma after BA/BSC
17= MA/MSC/Kamil & above
18= Hafezia/Kiratia/Nurani madrasa

O. Major source of income for the HH

1= Farmer/cultivator/Livestock/Poultry/Fishery
2=Agricultural labourer
3= Non-agricultural casual labour
4= MGNREGA work
5= Salaried worker (non-agricultural)
6= Own account employment (family or individual enterprise; non-agricultural)
7=
Collectives/SHG employment/business, non-agricultural
8=Government salaried worker
99= Others (Specify)

P. How frequently in a week does the main earning member go out for work?

0= Working from home permanently
1= Goes 1 day a week
2= Goes 2 days a week
3= Goes 3 days a week
4= Goes 4 days a week
5= Goes 5 days a week
6= Goes 6 days a week
7= Goes 7 days a week

Q. How does the main earning member commute to work?

0= does not need to, works from home full time

1= Personal, individual transport
2= Pool with trusted/known people
3= Public transport

R. Do you have a toilet in the household?

1 = Yes
0 = No

S. Do you share this facility with other households

1 = Yes
0 = No

T. Do you own the following in your household?

Items	Available?	
	1 =Yes	*0 = No*
a. TV	1	0
b. Air Conditioner	1	0
c. Computer / Laptop?	1	0
d. 2-Wheeler	1	0
e. Car	1	0
f. Washing Machine	1	0
g. Mixer / Grinder	1	0

U. Number of smart mobile phones used by your household members?

V. Are the members of the HH covered by any govt./pvt. Insurance that provides cover for hospitalization

1=No, no one is covered
2= Yes, but only some members covered

3= Yes, all members covered
97= Don't know

W. For how many years have you been living at your current place of residence?

X. Is this house rented or owned (rented/owned)?
1= Rented
2= Owned

Y. Religion of respondent: Hinduism -1, Islam -2, Christianity -3, Sikhism-4, Jainism -5, Buddhism -6, Zoroastrianism -7, others -9

z.Social group of respondent: Scheduled Tribes-1, Scheduled Castes -2, Other Backward Classes -3, Others/general category- 9

Appendix Section-3A: Note on choice experiment

As open ended questions on WTP may suffer from inherent bias, we use a modified double-bounded dichotomous choice contingent valuation method to ascertain WTP for robustness check. The self-reported certainty scales through the choice experiment can help in minimizing reporting bias (Alemu et al. 2021; Das et al. 2021). The question was posed as follows:

"*Suppose that when vaccines become available, it is priced at Rs 3000 per person (not necessary that this actually happens). Will you be willing to pay Rs. 3000 per person in your household for corona vaccine which is effective for almost each individual who are given the vaccine?"* If the response is positive, we ask a follow-up question that has seven options consecutively starting from Rs. 3500, Rs. 4000, Rs. 4500, Rs. 5000, Rs. 5500, Rs. 6000, and above Rs. 6000. For negative response the follow-up question with eight consecutive options is asked: Rs. 2500, Rs. 2000, Rs. 1500, Rs. 1000, Rs. 500, Rs. 300, Rs. 200, and finally less than Rs. 200. We repeated the same question for vaccines with lower efficacy (7 out 10 individuals). To ensure that the respondents understand the difference, the meaning of efficacy was explained with the use of examples.

Appendix Section-3B: Note on formative research on generalized trust

As discussed previously in the introduction, most surveys, such as the World Values Survey, measure generalized trust by asking respondents if they feel that most people can be trusted or if they instead feel the need to be careful when dealing with people? However, people in different settings are likely to have dissimilar interpretations about definition of "most people" and this presents a vital problem in measuring generalized trust (Delhey, 2011). To construct a more suitable measure of generalized trust, we first conducted focus group discussions (FGDs) with members of households from Berasia block in Bhopal district, based on which our questions on trust for the main survey were finalized. In these discussions, our focus was on understanding the social circle and interaction of the potential respondent in peri-urban areas who, despite residing in rural areas, regularly frequent Bhopal city for work. We found that even in somewhat homogeneous socio-cultural settings, approaching someone for assistance during a crisis or to resolve a dispute depends on characteristics such as "reliability" of the person being approached. This includes perceptions around the ability of the neighbour to keep family matters discreet, trust in people's opinion that has developed over the years, among others. Owing to these factors, households are quite careful in who to approach for assistance during times of crisis and disputes. In our discussions, we were careful in invoking the instance of a "sudden crisis", which was not purely financial in nature. For example, the discussions revolved around dimensions of health, family honour, financial crisis, etc.

Next, we found that residents in peri-urban areas also develop social relationships outside their caste group, particularly at their workplace that are in urban areas. Here, even though people switch jobs when a better offer arises, they often continue to stay in touch with each other through mobile phones. Since the telecom revolution in India, calling rates here are one of the cheapest in the world. [2] This facilitates communication amongst people, even when they cannot meet in person. Here, because we wanted to look at aspects of generalized trust outside of the immediate proximity (already captured), we focussed only on those friendships where people involved had not met each other in the last one or two years. Also, because we wanted to measure the intensity of this relationship, we were careful to structure the question to reflect that any financial help offered to such a friend would require the respondent to reduce their own household expenditures. Finally, our discussions revealed significant variation in aspects

[2] https://www.bbc.com/news/world-asia-india-47537201, last accessed May 20, 2022.

of altruism with respect to those who are not part of one's core social circle. Here, although respondents reported that they would assist unknown persons during emergency such as accidents, response to helping during something not very urgent was quite diverse. This information was used to construct our final question of generalized social trust. All these questions were together used to construct a radial measure of generalized social trust.

Appendix table T1: Definition of variables used

Variables used	
Outcome variables	
Likelihood of paying for vaccine with 100% efficacy	= 1 if maximum amount the respondent is willing to pay for each household member on average is more than zero for vaccines with 100% efficacy; 0 otherwise (for all those who are willing to take a vaccine with 100% efficacy)
Likelihood of paying for vaccine with 70% efficacy	= 1 if maximum amount the respondent is willing to pay for each household member on average is more than zero for vaccines with 70% efficacy; 0 otherwise (for all those who are willing to take a vaccine with 70% efficacy)
Main variables of interest	
Standardized social trust	Standardized after summing up of the standardized indicators outlined in the questionnaire (A1-A4) (appendix section-3B)
Social trust (PCA)	Index from Principal Component Analysis using A1-A4.
High a1	= 1 if the response is "High chance of helping"/ "Will surely help" to the question A1; 0 otherwise
High a2	= 1 if the response is "there is a high chance of trying"/ "I will surely try" to the question A2; 0 otherwise

High a3	= 1 if the response is “High chance of lending”/ “Will surely lend” to the question A3; 0 otherwise
High a4	= 1 if the response is “High chance”/ “Will surely approach” to the question A4; 0 otherwise
Covariates	
Female	= 1 if the respondent is female; 0 otherwise
Age of household head	Age of household head in years completed
Education	Years of completed education
Caste	= 0 if the respondent is from Other Backward Class social group; 1 if the respondent is from Scheduled Caste/ Scheduled Tribe social group and 2 if the respondent is from General Caste social group
Highest Education within household	Years of completed education of the household member with highest education
Number of earning members	Number of earning members in the household
Laborer	=1 if the main income source of the respondent’s household is agriculture/casual labor main income source; 0 otherwise
Standardized wealth index	Standardized after summing up of the standardized asset indicators outlined in the questionnaire (T) (appendix section 3)
Number of mobile phones	Number of mobile phones in the household
Income reduction in last one year	Income reduction as a share of monthly household income
Frequency of going outside for work	Number of days in a week the main earning member goes out for work
Uses public transport	= 1 if the main earning member goes out for work using public transport or pooling with trusted/ known people; 0 otherwise
Number of co-morbid individuals	= 1 if any member of household has with any of the following conditions: asthma (other lung related ailments), heart condition, diabetes,

	hypertension, who had any surgeries since the beginning of 2020, Liver ailments; 0 otherwise
Number of elderly	Number of elderly above 60 years of age in the household
Number of children	Number of elderly below 5 years of age in the household

Appendix Table T2: Analytical Sample

	Overall			Less than median social trust			Median or higher social trust			
Indicator	**N**	**Estimate**	**SE**	**N**	**Estimate**	**SE**	**N**	**Estimate**	**SE**	**Difference**
Share of women respondents	1251	0.17	0.03	557	0.21	0.04	694	0.13	0.02	-0.08***
Age of respondent (years)	1251	42.16	0.71	557	42.17	0.84	694	42.14	0.76	-0.02
Share of household head as respondent	1251	0.8	0.02	557	0.76	0.02	694	0.84	0.02	0.08***
Education level of respondent (Share)										
Primary or less (<=5th standard)	1251	0.47	0.03	557	0.5	0.03	694	0.44	0.03	-0.06***
Above Primary up to Middle (5th to 8th standard)	1251	0.19	0.01	557	0.19	0.02	694	0.19	0.02	0.00
Above Middle but up to Secondary (8th to 10th standard)	1251	0.17	0.01	557	0.14	0.02	694	0.2	0.01	0.06**
Above Secondary up to Senior Secondary (incl. diploma)	1251	0.09	0.01	557	0.09	0.01	694	0.1	0.01	0.01
Graduate & above	1251	0.08	0.02	557	0.08	0.02	694	0.08	0.02	0.00
Highest level of education in household (Share)										
Up to middle (8th standard)	1251	0.3	0.02	557	0.31	0.03	694	0.29	0.02	-0.02
Above middle but up to Secondary	1251	0.28	0.02	557	0.28	0.02	694	0.28	0.02	0.00
Above secondary	1251	0.42	0.03	557	0.42	0.03	694	0.43	0.03	0.01
Share of households with co-morbidities	1251	0.11	0.01	557	0.1	0.02	694	0.13	0.01	0.03
Number of elderly (>60 years)	1251	0.44	0.03	557	0.46	0.03	694	0.42	0.03	-0.04
Number of children (<5 years)	1251	0.4	0.03	557	0.36	0.04	694	0.44	0.03	0.08
Share with agriculture/casual labour main income source	1251	0.43	0.06	557	0.46	0.06	694	0.39	0.07	-0.07*
Number of earning members within household	1251	1.44	0.023	557	1.42	0.03	694	1.46	0.03	0.41
Caste (Share)										
OBC	1251	0.62	0.07	557	0.59	0.06	694	0.64	0.08	0.05
SC/ST	1251	0.28	0.06	557	0.32	0.05	694	0.26	0.06	-0.06*
General	1251	0.09	0.05	557	0.09	0.05	694	0.1	0.05	0.01
No. of mobile phones in HH	1251	1.06	0.07	557	0.89	0.08	694	1.2	0.06	0.31***
Standardized HH asset index (0-100)	1251	9.97	0.39	557	9.06	0.36	694	10.7	0.58	1.64**
Share of annual income reduction vis-a-vis last year	1251	61.86	2.14	557	64.08	1.6	694	60.09	2.89	-3.99*
Weekly frequency of going out for work (Share)										
Never	1251	0.49	0.07	557	0.64	0.11	694	0.37	0.05	-0.27**
1-6 days a week	1251	0.24	0.03	557	0.17	0.04	694	0.31	0.04	0.14**
7 days a week	1251	0.27	0.05	557	0.2	0.08	694	0.32	0.04	0.12
Standardized score for compliance norms (0-100)	1251	76.87	1.29	557	73.1	1.69	694	79.89	1.22	6.79***
Standardized score for trust in govt. (0-100)	1251	74.02	2.25	557	70.24	2.12	694	77.06	2.92	6.82**

Note: *** p-value <0.01, ** p-value <0.05, * p-value <0.10

Appendix Section-4: Bias adjusted treatment effects, IPWRA and Lee Bounds

Bias adjusted treatment effects

To isolate the selection bias, following Altonji et al. (2005) and Oster (2019), we examine the potential variation in the estimates after accounting for unobservables. This method assumes that the selection on observables is proportional to selection on unobservables by a hypothetical parameter δ. For further elaboration, consider the following regression equation:

$$Y = \beta Z + \varphi X + \mu \qquad (3)$$

Here Y is the dependent variable, Z denotes the primary variable of interest, X is the vector of control variables while μ denotes the vector of all omitted factors from the regression. We assess the associated changes in β when μ is substantially high. The primary assumption of this strategy is as follows:

$$\frac{cov(Z,\mu)}{Var(\mu)} = \delta \frac{cov(Z,\varphi X)}{Var(\varphi X)} \qquad (4)$$

The above equation underscores that the correlation between T and μ is associated linearly with the correlation between T and the observed component, which is φX. The degree of proportionality is given by δ.

It uses another hypothetical parameter (R^2_{max}), which is the explained variation in the regression model where all potential unobserved variables are incorporated into the linear regression along with the observables. Using data from a wide sample of randomized experiments, Oster (2019) proposes $R^2_{max} = 1.3 * R^2_0$ (R^2_0 is the R-squared value of the full model with observed control variables).[3] The literature on this method assumes effect of observables to be at-least as important as unobservables and thus considers a bound on δ that lies between [-1,1] (Rathore and

[3] According to Oster (2019), the bounding value of the cut off at 1.3 allows effects from at-least 90% of the random experiments to survive.

Das, 2021). The argument is that if $|\delta|$ goes beyond 1, the variation in the outcome explained by unobservable(s) has to be higher than the combined influence of all the observables put together to push the effect size of the coefficient of the variable of interest to zero. With a comprehensive set of controls, this is likely to be improbable. Accordingly, using R^2_{max}, we estimate the value of δ for which the coefficient of interest turns to zero. These set of δs are given in Appendix table T3.

IPWRA

In addition to the above coefficient stability test that is conducted, we also use the Inverse Probability Weighting Regression Adjustment (IPWRA) to estimate the unbiased treatment effect of social trust. Conceptually, IPWRA first estimates the probability of an individual having higher trust and then assigns the inverse of these weights while running the regression. Important to note here is the "doubly robust" property of IPRWA. This implies that the regression specification only requires either the treatment model or the outcome model and not necessarily both to be correctly specified to get unbiased estimates of the treatment effect (Wooldridge, 2010, Cattaneo, 2010). In STATA 16, we use the *ipwra* command to generate the estimates, which are presented in table 2. Here we use the median value of the standardized trust score as the cut-off (which is 0) and categorize the respondents into two categories: high trust score (treated) and low trust (non-treated). Accordingly, respondents with trust score greater than 0 as categorized as treated and hence assigned the value of "1" and those with a score of 0 or below are categorized as non-treated and hence assigned a value of "0". The findings indicate robust and statistically significant positive effect of generalized trust on the likelihood of paying for both the types of COVID-19 vaccine.

Lee Bounds

Notably, in all our regressions, we drop respondents, who are hesitant to take vaccine. To account for the potential non-random attrition bias because of non-inclusion of these respondents, we use Lee bounds to estimate the effects with adjusted upper and lower bounds. Arguably, this is a commonly used approach to produce the treatment effect bounds after accounting for the selection bias that are robust to differential attrition (Lee, 2009; Haushofer and Shapiro, 2017; Das et al. 2023). Here, as well, we find both these bounds to be significantly higher than zero, thereby

providing evidence for a clear relationship between generalized trust and likelihood of paying for COVID-19 vaccines (Table 2). This lends credence to the public good feature of the vaccine wherein individuals put significant weightage to the social benefits derived from vaccines when they consider paying for it.

Appendix table-T3: Robustness checks-2

	Likelihood to pay	**Willingness to pay**	**Choice Experiment**
	Estimates of δ following Altonji et al. (2005)		
R^2	0.29	0.35	0.23
R^2_{max}	0.38	0.46	0.299
δ	1.31	1.36	1.43
	Inverse Probability Weighting Regression Adjustment (IPWRA)		
ATE	0.156	0.914	0.114
	(0.019)	(0.107)	(0.-027)
	Lee bounds		
Lower	0.2245	1.507	0.219
	(0.021)	(0.121)	0.025
Upper	0.2270	1.52	0.0221
	(.022)	0.128	(0.025)

Appendix Section-5: Plausibly exogenous

It is possible that the strict exogeneity condition of the IV is not satisfied due to which the 2SLS estimates might be biased. To account for these possibilities, Conley et al. (2012) suggest techniques which allows us to assume that the IV is only 'plausibly exogenous'. In this framework, we consider the equation below:

$$y_i = \beta GST_i + \gamma z_i + \theta X_i + \varepsilon_i \qquad (2)$$

Here y_i are the outcome variables, GST_i refers to the generalized trust and z_i is the IV with i denoting a repsondent. X_i is the vector of controls. The main results that is discussed through Appendix table T-4 in the main text assume that the parameter γ=0. If γ is close to zero, but not zero, the IV can still be 'plausibly exogenous' and we can get consistent estimates of the impact of social trust for certain values of γ. Existing studies have used this technique in different contexts (McArthur et al., 2017; Azar et al., 2021; Das, 2021; Biswas and Das, 2022). Here, we first estimate the reduced form effect of the IV by regressing the outcome variables on the IV and other covariates, while excluding the main variable of interest (Appendix table T-4). We obtain the value of $\hat{\gamma}$ from this step. Next, we estimate the bounds for the second-stage effect of trust on the outcome variables while assuming that the direct effect of the IV ranges from zero, which indicates it is perfectly exogenous to the reduced form effect. The values of the estimated γ_{max} presented in Appendix table T-4 for the three outcome variables indicate that generalized trust will continue to have a discernible effect on paying for vaccines even if the direct effect of the instruments is 32%-44% of the reduced form effect.

Appendix table-T4: Plausibly exogenous instrument regressions

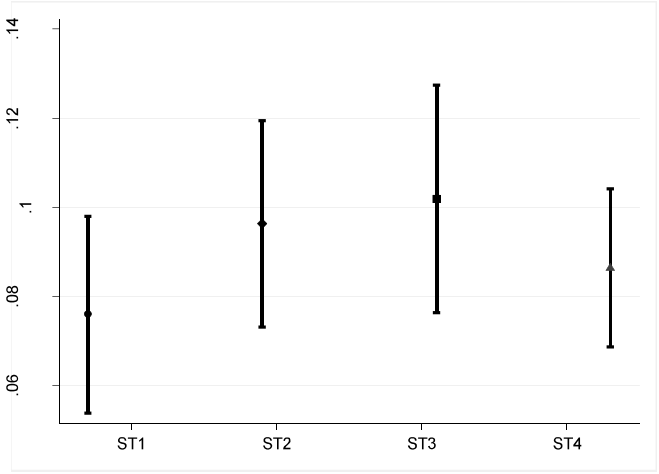
	LTP	WTP	Choice Experiment
$\hat{\gamma}$	0.042***	0.271***	0.053***
	(0.016)	(0.088)	(0.019)
Individual and households controls	Yes	Yes	Yes
Trust with government	Yes	Yes	Yes
COVID-19 norm compliance	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes
R-squared	0.230	0.299	0.231
$\hat{\beta}$(lower bound)	-0.154	-0.878	-0.207
$\hat{\beta}$(upper bound)	0.397	2.404	0.495
γ_{max}	0.018	0.12	0.017

Appendix Table-T5: Robustness checks 1

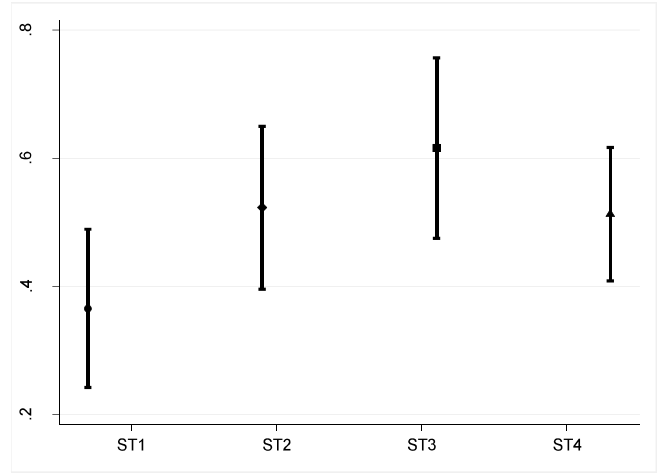
	LTP			WTP			Choice Experiment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Social Trust	0.127***			0.705***			0.054***		
	(0.018)			(0.088)			(0.016)		
PCA of trust		0.082***			0.458***			0.037***	
		(0.008)			(0.042)			(0.009)	
Higher than median level of trust			0.161***			0.953***			0.117***
			(0.021)			(0.119)			(0.028)
Individual and households controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trust with government	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COVID-19 norm compliance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,133	1,219	1,219	1,133	1,219	1,219	1,133	1,219	1,219
R-squared	0.304	0.289	0.243	0.363	0.348	0.312	0.233	0.230	0.233

Note: Marginal effects from OLS regressions are presented with robust standard errors. Columns 1, 4 and 7 have used standard errors clustered at the 500m clusters. In Columns 2, 5, 8, we regressed of PCA value of social trust. Columns 3, 6 and 9 looks at the effects for over the median value of trust. $^{*}\ p < 0.1$; $^{**}\ p < 0.05$; $^{***}\ p < 0.01$

Appendix figure-F1: Likelihood to pay



Appendix figure-F2: Willingness to pay



Appendix figure-F3: Choice experiment