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Present Bias Predicts Low Adoption of Profitable Technologies: The Case of Livestock Vaccination in Northern Laos

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Present bias predicts low adoption of profitable technologies:

The case of livestock vaccination in northern Laos

Christian Creed*

Abstract

Can behavioural characteristics explain the low adoption of profitable technologies? We explore this question by quantifying the importance of present bias on cattle producers' decision to vaccinate against foot-and-mouth disease, a simple and well-known technology that, despite its high returns, is largely overlooked. Our results show that producers who exhibit a stronger present bias are much less likely to vaccinate their cattle, an effect which is robust to a large set of control variables (including wealth and access to information), larger than the effect of any other observed covariate and insensitive to plausible assumptions about the importance of unobserved determinants of adoption. We discuss some of the potential implications of these results for the design of vaccine delivery and to other policies that aim to overcome self-control problems.

JEL Codes: O10, O13, Q16

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Appendix Link: **Appendix**

1. Introduction

Existing estimates of the benefit cost ratio of vaccinating cattle against foot and mouth disease (FMD) suggest that there is a US$5.3 return per dollar spent on vaccinations in northern Lao PDR (hereafter Laos) (Nampanya, et al. 2018). However, despite such large returns, data from the same region suggests that more than 70% of producers fail to vaccinate against this disease suggesting that vaccination against FMD seems to be another puzzling example of something that should not exist: large bills left on the sidewalk.

Although there may be technology specific explanations for this puzzle, it is important to note from the onset that it is not unique to vaccinations. Experimental estimates show that the returns to capital in developing countries can be as high as 70%, yet investment opportunities are frequently overlooked (Kremer, Rao and Schilback 2019). This is true even in the case of divisible investments, such as fertilizer, an input with very low adoption rates in many Sub-Saharan African countries despite its known availability and agricultural profitability (Duflo, Kremer and Robinson 2011).

Building on the "poor but rational" paradigm (Schultz 1964), conventional explanations for this behaviour emphasize the importance of external constraints created by market failures, particularly in credit and information markets, as the main drivers for low adoption (Feder, Just and Zilberman 1985), however, these explanations are unlikely to paint the whole picture. Banerjee and Duflo (2007) illustrate numerous examples where "rational" decision makers have access to the means of escaping poverty, for example through investment into divisible and profitable technologies, but repeatedly fail to do so. A leading potential complementary explanation for such behaviour is that although the poor exhibit as many failures of rationality as anyone else, the consequences of such failures are simply more damaging to their welfare.

Behavioural economics research has shown that, for some individuals, the decision to allocate a budget between two time periods depends on the proximity of the future (Thaler (1981); see Ericson and Laibson (2019) for a recent review). As such, inconsistency between current actions and future plans are commonplace and consequently, the inconsistencies are among the most analysed implications of such preferences, which are parsimoniously captured in the $\beta - \boldsymbol{\delta}$ model (Laibson 1997, O'Donoghue and Rabin 1999).[1] This paper explores the predictive power of this explanation for the low adoption of livestock vaccination against Foot-and-Mouth Disease among beef producers in northern Laos.

The remainder of this paper proceeds as follows. Section 2 contextualises the significance of FMD control in Laos and presents a brief review of common explanations for the low adoption of vaccination. We highlight that, contrary to a growing attention to vaccination against human diseases, there has been a generalized lack of attention to behavioural explanations for this behaviour. Section 3 outlines the data used in this paper while section 4 presents the results, showing that individuals who exhibit a strong preference for the present are also less likely to vaccinate their cattle. This result is precisely estimated, economically significant and robust to the inclusion of a large number of other explanations of non-adoption. Using the sensitivity analysis proposed in Oster (2019), our results also suggest that this effect is robust to the influence of unobserved determinants of the vaccination decision. We conclude in Section 5 with a discussion of the policy implications of these findings.

[1] Formally, such preferences can be represented as

$$U=ut+[\delta\ ut+1+2\ ut+2+3\ ut+3+\ldots+n\ ut+n]$$

where u measures the utility of consumption at time t, $\boldsymbol{\delta}$ is the discounting factor and β measures individual uniform discounting of all future periods and is a measure of how much the present is salient in individual's choices (i.e, of present bias). When $\beta = 1$, present bias has no influence on inter-temporal preferences and this expression converts to the standard model of intertemporal choices that leads to consistent preferences.

2. Foot and Mouth Disease and the puzzle of low adoption of vaccination

Foot and Mouth Disease (FMD) is a highly transmissible viral disease that affects cloven-hoof animals, including, but not limited to, cattle and buffalo. Infected animals develop fever, inappetence, lameness and the development of lesions in the mouth and feet of affected animals, limiting their mobility and feeding ability. Although mortality is usually low among adult cattle (less than 2%), these symptoms lead to loss of body weight, productive capacity and, ultimately, value.

Most importantly, given its high morbidity (which can easily reach 90-100% of the animals that directly or indirectly contact a sick animal) , international guidelines (OIE, 2014) severely limit the trade of susceptible animals and their products. Such trade barriers are present not only between FMD-free countries (essentially, developed countries) and those where the disease is present, but also between countries with the disease, given the existence and spatial delimitation of different variants of the virus responsible for the disease. Such barriers prevent potential exporting countries from accessing markets with higher meat prices (including, increasingly, China and other middle-income countries), depriving producers in affected countries from benefiting from what Delgado et al (1999) called “the livestock revolution”.

Despite a long history of efforts to eradicate this disease (Blancou, 2002), FMD-free status has mostly been limited to developed countries and most recently, Latin American countries. This distribution reflects the benefits of disease eradication (potentially much higher for countries with a comparative advantage in livestock production) as well as the capacity to implement a host of biosecurity measures, from the culling of infected animals through comprehensive capacity in most extreme cases to quarantine and controlled movement of animals, and including the capacity to mass vaccinate animals when FMD-free status is not achievable in other ways. In Southeast Asia, FMD is classified as ‘eradicated with vaccination’ in Indonesia and The Philippines, reflecting long efforts to control the disease that were simplified by the insular nature of the two countries, while being considered endemic in the mainland (Blacksell, et al. 2019).

In Laos, the setting of our study, its place as a transit hub in the transboundary live trade in South East Asia, through which cattle originating from as far as Bangladesh and western Myanmar transit en-route to the growing Chinese market, is believed to be at the origin of frequent epidemic break-outs (Khousny, et al. 2008), with important impacts on the livelihoods of Laos’ cattle producers. Nampanya, et al. (2018) estimate the cost of lost animal productivity at US$13 million, a value that is approximately 5% of the total revenue from livestock exports.

Vaccination plays a role in programs intended to limit such losses as it is widely seen as one of the most cost-effective ways of protecting the health of susceptible livestock (FAO 2020) given its low cost (US$2.1 -US$2.5 per vaccinated animal, including the cost of its delivery) and high efficacy (lowering infection to as low as 1%, when the entire local herd is vaccinated). Reflecting these values, Nampanya, et al. (2018) estimate a benefit-cost ratio of 5.3 for this investment. With such attractive returns, it is reasonable to expect the continuation of high vaccine adoption rates once mass livestock vaccination programs are completed. However, this has not been the case, with vaccination rates often drastically falling after the conclusion of such programs.

Attempts to explain the low adoption of livestock vaccines are limited, and those that focus specifically on FMD are even more limited. As with other studies of technology adoption, they share a conceptualization of the adoption decision as being driven by a cost benefit analysis, with non-adoption resulting from different market failures, usually focusing on either supply-side failures (and emphasizing the limitations with the manufacturing or distribution of such vaccines), or demand-side failures (usually stemming from financial or informational constraints, high transaction costs and, increasingly, intra-household frictions associated with gender roles).Without being exhaustive, the analysis of this body of work suggests several conclusions.

Firstly, the cost benefit analysis assumes that supply-side barriers, such as weak veterinary services and poor storage and distribution infrastructure, are solved, i.e that vaccines are available. Although availability is mostly beyond the household's control (as it depends on the manufacturing and distribution of the vaccine), it is likely to have consequences on the demand for vaccines (Donadeu, et al. 2019). For example, if vaccines are not stored properly, livestock producers may be sceptical about incurring the cost of vaccination, given the uncertainty of its efficacy.

Secondly, the conventional explanation for non-adoption focuses on the importance of financial constraints. Poor households would face, by definition, major liquidity constraints, with limited opportunity to access the funds necessary for financing vaccinations, regardless of initial intentions (Railey, et al. 2018). It is also suggested that wealthier households are more capable of absorbing any shocks from any negative side-effects of adoption, thereby reducing the risks of adopting new technologies (Bola, Wiredu and Diagne 2012).

Thirdly, accessibility to vaccinations may matter, as it determines the importance of non-monetary transaction costs, including the opportunity costs of time dedicated to accessing vaccination services. Most commonly, excessive waiting times, difficult to reach vaccination points and poor transportation infrastructure are all likely to increase the perceived costs of vaccination given the opportunity cost of time, as well as greater travel and transaction costs, or the less quantifiable discomfort (and associated disutility) of having to overcome such barriers. It is possible that, once these additional heterogeneous costs are taken into account, estimates of benefit-cost ratio from vaccination become negligible (Railey, et al. 2018).

Finally, among the more traditional explanations for non-adoption, disease knowledge has also received some attention, following the intuition that being aware of the real effects of a disease as well as of the effectiveness of vaccines may provide motivation for producers to vaccinate their livestock (Donadeu, et al. 2019). This had guided work on the provision of information as a way to combat low adoption rates of vaccines, although the effectiveness of these initiatives is largely unknown.

Finally, contrary to vaccination decisions in human health (Brewer et al 2017), behavioural explanations have not attracted much attention. Measures such as locus of control, trust and present-bias, that have received attention in other related contexts, have been largely ignored when explaining the lack of adoption of livestock vaccination. In this article, we focus on the role that time preferences may play in explaining the low adoption of vaccines.[2] Vaccination incur an immediate cost (in money or discomfort) in order to receive a future payoff in the form of healthier livestock. As present bias reflects a desire for instant gratification, individuals who exhibit those preferences are more likely to procrastinate, postponing costly immediate decisions (like vaccination) while constantly electing to adopt in the future.

3. Data

We use household data collected as part of a study on the impact of decentralized provision of extension services (Santos, et al. 2020). The data was collected in November 2019 among 852 households in 71 villages in four districts of northern Laos (figure 1). Among the households surveyed, 616 raised cattle and, as elsewhere in the region, the adoption of vaccination against FMD is low: only 173 producers (less than 30%) vaccinated all or part of their herd in the previous 12 months. In addition to data on the decision to vaccinate, the

[2] On Locus of control and the adoption of fertilizer in Sub-Saharan Africa, see Abay, Blalock and Berhane (2016). On the role of trust, see Mutua, et al. (2019).

survey collected information on a large number of variables that proxy for the different constraints to vaccinate identified in the literature referenced in the previous section.

[Figure 1]

Our main focus is on the importance of present bias, which we measured through the use of a convex time budget (CTB) as in Andreoni and Sprenger (2012). Respondents were asked to choose between a smaller payment earlier versus a larger payment later, where both earlier and later were one of three different time intervals (today, in 4 weeks, and in 8 weeks).[3] These choices allow us to estimate two parameters: a measure of present bias, β and a discount factor $\boldsymbol{\delta}$. Similarly to several other field studies (Ashraf, Karlan and Yin 2006, Clot and Stanton, 2014) approximately 25% of the respondents prefer the earlier payoff in all choices, preventing us from obtaining estimates of the two parameters of interest (β and $\boldsymbol{\delta}$). In the analysis, we assume that $\beta = \boldsymbol{\delta} = 0$ for these respondents and include a dummy variable indicating such extreme present bias to control for such assumption. In addition, two observations with very large estimates of future bias ($\beta > 2$) were excluded from the analysis and one respondent did not respond to the CTB task. The median of these two parameters, representing a preference for the present per day, are 0.987 (β) and 0.991 ($\boldsymbol{\delta}$), are similar to those found in other studies (Andreoni and Sprenger (2012), Clot and Stanton (2014)). Figures 2 and 3 present the distribution of present bias (β) and discount factor ($\boldsymbol{\delta}$) for the 613 observations used in our analysis.

[Figure 2]

[Figure 3]

In addition to whether a household decided to vaccinate and time preferences, we have data on several proxies for wealth, specifically in terms of different types of assets (durable assets, agricultural assets and transport assets, all measured as indexes estimated using principal

[3] See appendix A for the table of payoffs.

component analysis), herd size (number of cattle and buffalos owned by the household) and land (crop and pasture/forest area owned by the household, measured in hectares).[4] Together, they proxy for the capacity to afford vaccination services, a motive that has received significant attention as one of the larger barriers to adoption, as discussed in the previous section.

Access to vaccines and vaccination services is another common motive addressed in the literature and a possible confounder in the decision to vaccinate. We proxy for this constraint by including proximity to the district headquarters in terms of distance (km) and in terms of travel time (hours), distinguishing between dry and wet seasons, as control variables.

Although we do not have data on knowledge about the disease or the subjective evaluation of vaccine efficacy, we can control for number of extension visits by District Agriculture and Forestry Organisation (DAFO) officers and whether the village was allocated to the pilot extension program mentioned at the start of this section.

Finally, we also control for the role of gender in livestock management, by accounting for two pathways through which women are involved in raising livestock: a dummy variable for whether a female (household head or otherwise) has decision-making autonomy concerning cattle management practices (i.e. if females decide on the management or sales of cattle) and a dummy variable which indicates if at least one female household member is involved in the day-to-day activities of raising cattle. Additionally, as part of our demographic variables, we include a third dummy variable which identifies whether the household head is female.

In addition to these variables, that proxy for the typical explanations for lack of adoption of vaccines, we also include a set of variables that are potentially important but have, so far, been neglected: risk preferences, trust and locus of control.

[4] We used principal correspondence analysis to summarize each respective group of assets into the relevant asset index.

Risk aversion is quantified using the approach presented in Eckel and Grossman (2003). Respondents are asked to select their preferred option when presented with several pairs of (real) payoffs with the probability 50:50 of receiving it.[5]

Trust was quantified by asking respondents about their confidence regarding the return of their wallet if it were to be lost containing 200,000KIP (roughly AU$30) and their own personal information. The question was asked if the wallet was found by someone from inside or outside their village, allowing us to quantify levels of trust towards fellow villagers and outsiders. Finally, we control for locus of control (LOC), a psychological concept that refers to the strength of belief that people have control over the situations and experiences that affect their lives.[6]

We present summary statistics for these variables in Table 1, distinguishing between producers who do not vaccinate (column (1)) and those who do (column (2)). Column 3 shows that although we find no obvious difference in terms of time preferences, households that vaccinate are wealthier in terms of durable and transport assets but less wealthy in terms of agricultural assets and crop land, which may suggest some degree of specialization in production. Households which vaccinate also live closer to district headquarters (in terms of both distance and travel time), and are more likely to live in villages which were randomly allocated to receive the extension program mentioned at the start of this section. They are also more likely to be headed by a woman, although there seems to be no difference in terms of female participation or decision making status in cattle production. Finally, households which vaccinate also scored higher on the internal locus of control questions, indicating they believe that they have greater control over the outcomes in their life.

[Table 1]

[5] See appendix B for the description of this task.

[6] Respondents were asked 16 questions incorporating both internal and external factors subsequently creating two measures of LOC. See appendix C for the specific questions.

4. Empirical estimates

We are interested in estimating the impact of time preferences, in particular present bias, on the decision to vaccinate cattle against FMD. We start by regressing this decision on the measures of time preferences (β and $\boldsymbol{\delta}$) only and then sequentially adding the additional explanations discussed in section 2. More formally we use OLS to estimate the following:

$$V = f\,[\beta, \boldsymbol{\delta}, M, X, \varepsilon]$$

where V is a dummy variable that equals 1 if the cattle producer vaccinated all or part of their herd and 0 otherwise, β and $\boldsymbol{\delta}$ represent present bias and discounting, M represents other motivations/constraints for adoption discussed in section 2 and X is a set of control variables (gender, age and education of the household head, and district fixed effects), while ε represents an error term, clustered at village level. To facilitate the comparison of the relative importance of the effect of these very different variables, they were standardised to have means of 0 and standard deviation of 1.

The results are presented in table 2. In column 1 we present estimates of the impact of present bias and discounting alone, where we also include a dummy variable that is equal to one if the respondent always prefers the earlier payment (extreme present bias: $\beta = \boldsymbol{\delta} = 0$). Estimates in column (2) additionally control for demographic variables and district fixed effects. We then include wealth, accessibility, and gender (columns 3 to 5, respectively), the most commonly addressed explanations for lack of adoption of this technology. Finally, in column 6 we include other behavioural characteristics (LOC, trust and risk aversion). To facilitate a judgement on the relative importance of each of these explanations, figure 4 graphically presents the estimates of the effect of each of these variables.

[FIGURE 4]

These results provide three main conclusions. Firstly, the magnitude of the effect of present bias and discounting is of clear importance: an increase of one standard deviation in the value of β increases the probability of adoption by more than 14 percentage points, an effect that is substantially larger than that of the second largest influence, durable assets ownership. The second conclusion is that the magnitude of the effect is largely unchanged across the different specifications. Finally, although the inclusion of additional control variables reduces the precision of our estimates, present bias is always significant at the 5% level.

[Table 2]

In testing the robustness of our results, we use two different approaches. Firstly, we examine whether these results reflect either the importance of extreme present bias or of future bias. We do that by restricting the estimating sample, first by excluding those observations that exhibit extreme present bias (i.e, $\beta = \boldsymbol{\delta} = 0$) and secondly, by excluding the observations where $\beta > 1$. The results, presented in Table 3, demonstrate that our conclusions remain unchanged regarding the importance of present bias in explaining this decision.

[Table 3]

This conclusion is further reinforced through the estimation of a partial linear regression, where we investigate the possibility of a non-linear relation between the decision to vaccinate and present bias, conditional on the assumption of a linear relation with all other covariates. Figure 5 shows no evidence of such non-linearity.

[Figure 5]

Our second robustness test analyses of the stability of our estimate of present bias with respect to omitted variables, as outlined by Oster (2019). Here, we assume equal covariance between the observed and unobserved variables in the model, and that the maximum R^2 after accounting for the unobserved variables is 1.3 times the value of the R^2 in table 2 (i.e, R_{max} =

0.215). Under these assumptions, the estimated lower bound of β is 0.013 > 0, suggesting that our conclusion regarding the importance of present bias is robust to reasonable assumptions about the importance of unobserved variables.

5. Conclusion

The results presented in the previous section support the hypothesis that present bias matters in predicting vaccination of cattle against FMD. This result seems intuitively reasonable as deciding to vaccinate involves incurring an immediate cost with a benefit to be realised much further into the future. In the absence of strict deadlines to vaccinate, even cattle producers who are aware of their tendency to procrastinate (sophisticates) may fail to act. Given the likely costs of this decision, and the importance of livestock both to local livelihoods and the economy (Pica-Ciamarra, et al. 2011) present bias may be one of the behavioural explanations for the puzzle of poverty persistence.

Ultimately, the aim of this research is to contribute to the improvement in living standards in livestock reliant communities through understanding the challenges, solutions and benefits of protecting livestock's productive capacity. The importance of this aim is certainly evident in the case of Laos, where livestock production has increased dramatically since 2006 (World Bank 2020) with consistent annual growth rates of 5% among herd sizes for the past decade (Napasirth 2018). Vaccination is of large importance in such context as its benefits are likely to extend far beyond food security and higher incomes, and towards other crucial livelihood decisions such as education (Marsh, et al. 2016). Hence it is important to discuss the policy implications of these results.

In considering ways to overcome this bias, it is central to differentiate between sophisticated and naïve decision makers. The latter refers to the underestimation of future present biases when deciding, causing a perpetual deferral of acting today on the premise that it will be incurred tomorrow. Sophisticated decision makers, on the other hand, have the ability to foresee future present bias and act on it, leading to an eventual, if delayed, investment (O'Donoghue and Rabin 1999). Taken together, the importance of present bias and the distinction between naïve and sophisticated decision makers suggest that slight changes in the choice architecture faced by producers may nudge them to adopt this technology with minimal intervention (Thaler, Sunstein and Balz 2012). In other words, changing the structure of how vaccinations services are offered is likely to have large implications in its adoption.

One example of such changes is the definition of commitment devices, that have been shown to have a large and direct impact in addressing present bias (Bryan , Karlan and Nelson 2010). For example, Duflo, Kremer and Robinson (2011) show that collecting payment for fertilizer immediately after harvest, when cash is readily available, but prior to its delivery and application, not only induced more fertilizer uptake, but also led to larger welfare gains compared to offering a large subsidy at the time of application.

An alternative type of commitment mechanism could potentially rely on the use of social capital (Bryan , Karlan and Nelson 2010). Creating mutual obligations to vaccinate, via regular meetings of a group of livestock producers, could hold each other accountable to effectively vaccinate their animals, similar to Rotating Savings and Credit Association (ROSCA) and microfinance models, as a failure to do so would have negative consequences on their social status.

Finally, the conceptual similarities between the economic literature on present bias and the psychological literature on self-control suggests that several other options may also be worth exploring. Firstly, the definition of plans, coupled with the use of specific prompts and reminders (Milkman, et al. 2011) has been shown to increase the adoption of preventive health care. Secondly, the concept of defaults may also be of interest, as it has been shown to induce desirable behaviour while also changing individual perceptions on such behaviours to see long-term shifts in preferences (Blumenstock, et al. 2018). Currently, the default in vaccination services is to opt-in to the program. A modification where farmers have to opt-out, thereby asking cattle producers to explicitly cancel vaccination, could also improve uptake of vaccinations (Yan and Yates 2019). Although such mechanisms may face logistical problems in developing countries, their consideration enlarges the set of potential solutions to the challenges posed by present bias.

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Figures

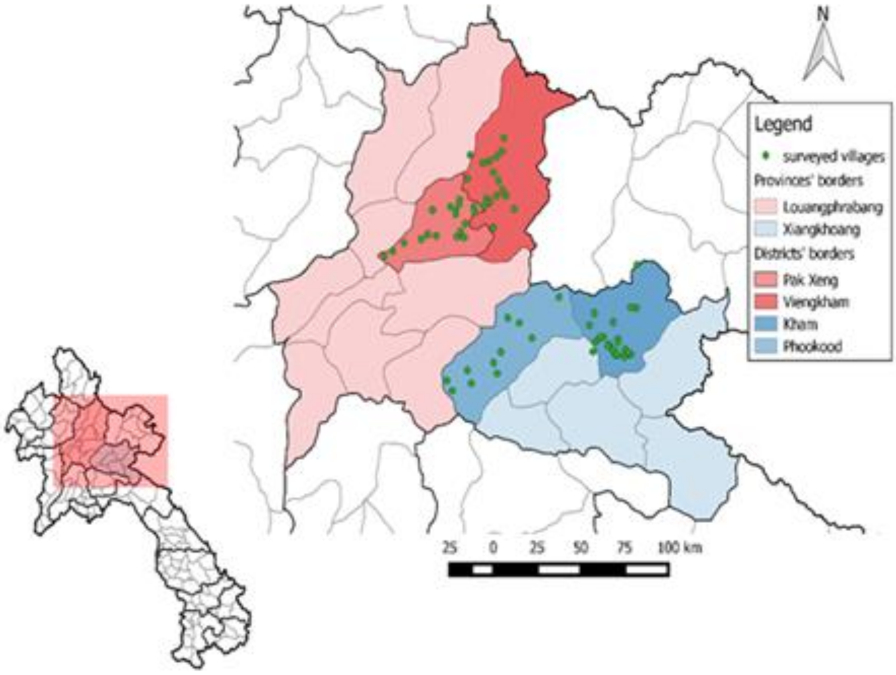

Figure 1: Map of surveyed villages in Laos

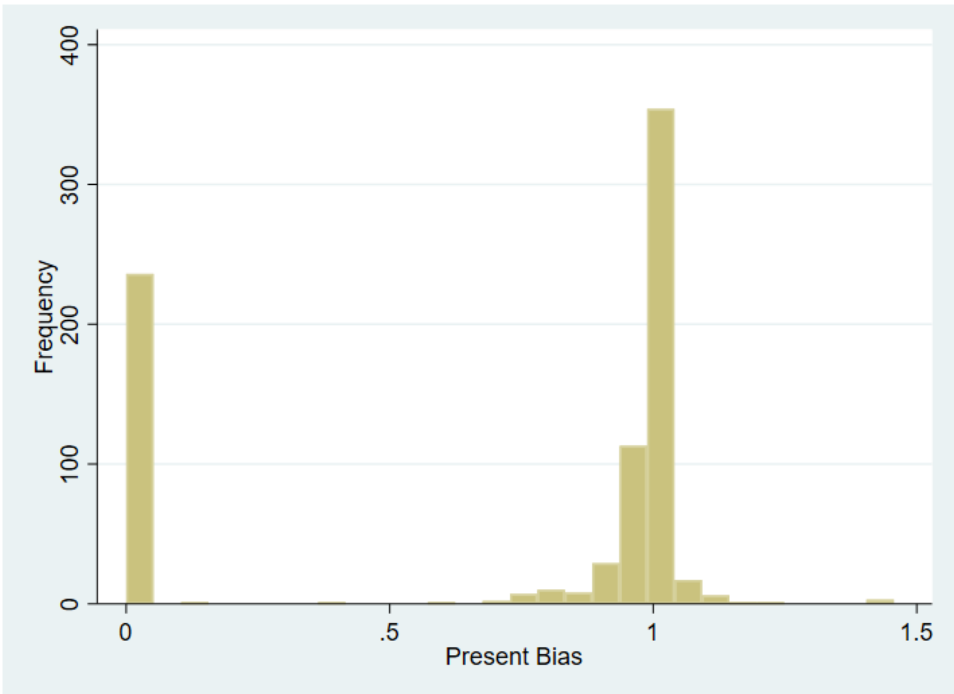

Figure 2: Distribution of present bias

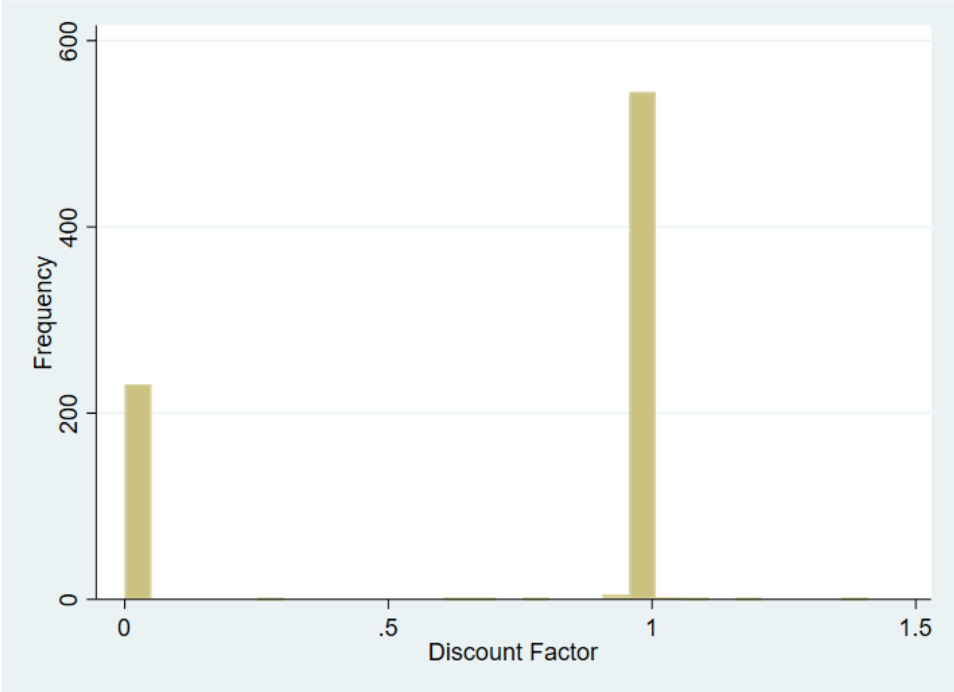

Figure 3: Distribution of discounting

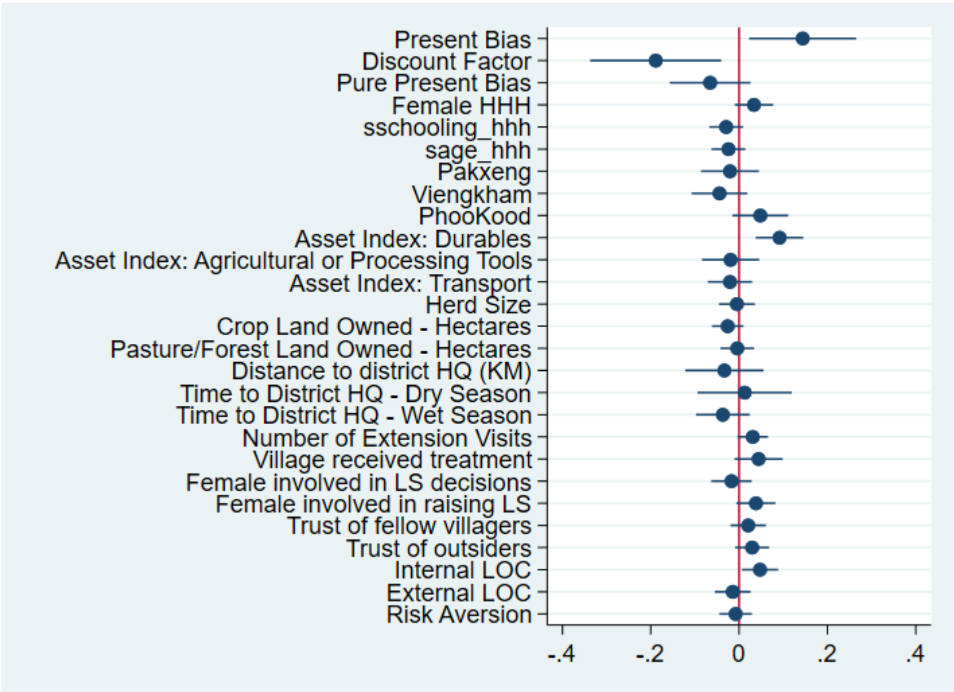

Figure 4: Explaining the decision to vaccinate against FMD (standardised coefficients with 95% confidence intervals)

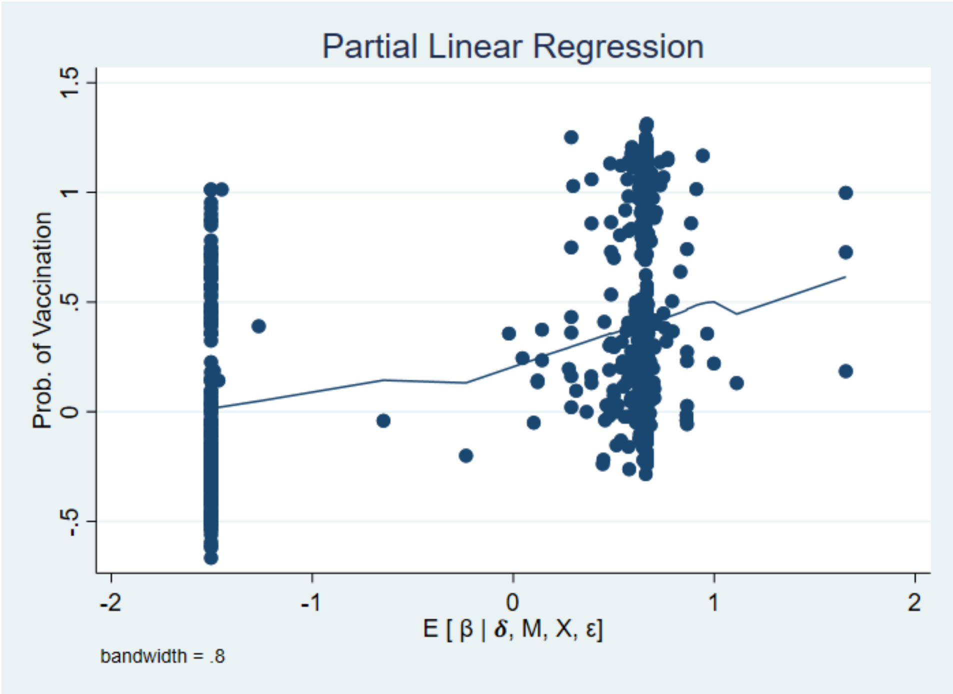

Figure 5: Non-linear relationship between vaccinating and present bias

Tables

Table 1: Summary Statistics: non-adopters vs adopters

		Non-Adopters (1)	Adopters (2)	Difference
Motivation	Variable	Mean / [SD]	Mean / [SD]	(1)-(2)
Time preferences	Present Bias	0.691	0.693	-0.001
		[0.022]	[0.035]	
	Discount Factor	0.711	0.688	0.024
		[0.021]	[0.035]	
Demographics	Female Household head	0.025	0.052	-0.027*
		[0.007]	[0.017]	
	Education Household Head (years)	46.427	47.509	-1.081
		[0.612]	[0.946]	
	Age of the Household Head	5.164	5.324	-0.160
		[0.136]	[0.223]	
Wealth	Asset Index: Durables	-0.060	0.527	-0.587***
		[0.045]	[0.056]	
	Asset Index: Agricultural Tools	0.036	-0.439	0.475***
		[0.046]	[0.088]	
	Asset Index: Transport	0.050	0.270	-0.221**
		[0.048]	[0.070]	
	Herd Size	8.807	9.341	-0.534
		[0.358]	[0.658]	
	Crop Land Owned – Hectares	3.228	2.516	0.712***
		[0.144]	[0.205]	
	Pasture/Forest Land Owned – Hectares	0.743	0.585	0.158
		[0.084]	[0.110]	
Access	Distance to district HQ (KM)	28.302	22.445	5.857***
		[0.868]	[1.417]	
	Time to District HQ – Dry Season	0.973	0.676	0.296***
		[0.035]	[0.047]	
	Time to District HQ – Wet Season	2.032	1.275	0.757***

		[0.143]	[0.148]	
	Number of extension visits	4.375	4.809	-0.434
		[0.186]	[0.260]	
	Treatment village	0.432	0.607	-0.175***
		[0.024]	[0.037]	
Gender	Trust of fellow villagers	0.636	0.618	0.018
		[0.023]	[0.037]	
	Trust of outsiders	0.648	0.671	-0.023
		[0.023]	[0.036]	
Behavioural	Female involved in Livestock decisions	3.101	3.219	-0.118***
		[0.017]	[0.027]	
	Female involved in raising LS	2.601	2.581	0.020
		[0.019]	[0.033]	
	Internal LOC	0.375	0.410	-0.035
		[0.023]	[0.038]	
	External LOC	0.027	0.035	-0.007
		[0.008]	[0.014]	
	Risk Aversion	1.849	1.764	0.085
		[0.121]	[0.191]	
	N	440	173	

Note: ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 2: Impact of present bias on the vaccination decision

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Time Preferences	Time Preferences	+ Wealth	+ Access	+ Gender	+ Behavioural
Present Bias	0.177***	0.158***	0.152***	0.143**	0.137**	0.144**
	(0.050)	(0.048)	(0.053)	(0.057)	(0.058)	(0.061)
Discount Factor	-0.197***	-0.186***	-0.173**	-0.175**	-0.169**	-0.189**
	(0.062)	(0.062)	(0.068)	(0.069)	(0.071)	(0.074)
Extreme Present Bias	-0.018	-0.048	-0.043	-0.052	-0.054	-0.066
	(0.044)	(0.042)	(0.043)	(0.042)	(0.043)	(0.046)
Asset Index: Durables			0.125***	0.086***	0.087***	0.092***
			(0.024)	(0.026)	(0.025)	(0.027)
Asset Index: Agricultural or Processing Tools			-0.025	-0.021	-0.023	-0.019
			(0.031)	(0.031)	(0.031)	(0.032)
Asset Index: Transport			-0.008	-0.021	-0.020	-0.021
			(0.024)	(0.025)	(0.025)	(0.025)
Herd Size			-0.005	0.000	-0.001	-0.005
			(0.020)	(0.020)	(0.020)	(0.020)

Crop Land Owned - Hectares	-0.036**	-0.030*	-0.029	-0.026
	(0.017)	(0.018)	(0.018)	(0.018)
Pasture/Forest Land Owned - Hectares	-0.007	0.001	0.001	-0.004
	(0.019)	(0.018)	(0.019)	(0.019)
Distance to district HQ (KM)		-0.032	-0.036	-0.033
		(0.044)	(0.045)	(0.044)
Time to District HQ - Dry Season		0.007	0.011	0.013
		(0.053)	(0.053)	(0.054)
Time to District HQ - Wet Season		-0.030	-0.034	-0.037
		(0.028)	(0.029)	(0.030)
Number of extension visits		0.027*	0.026	0.031*
		(0.016)	(0.016)	(0.017)
Treatment village		0.048*	0.047*	0.044
		(0.027)	(0.027)	(0.027)
Female involved in making decisions (dummy)			-0.016	-0.017
			(0.023)	(0.023)
Females involves in raising Livestock (dummy)			0.039*	0.038*
			(0.022)	(0.022)

Internal LOC						0.047**
						(0.021)
External LOC						-0.014
						(0.020)
Trust of fellow villagers						0.021
						(0.020)
Trust of outsiders						0.029
						(0.019)
Risk Aversion						-0.008
						(0.018)
Constant	0.284***	0.280***	0.273***	0.276***	0.275***	0.274***
	(0.032)	(0.027)	(0.024)	(0.024)	(0.024)	(0.023)
Observations	613	613	613	613	613	613
R-squared	0.010	0.065	0.121	0.143	0.148	0.165
F stat	0.003	0.001	0.000	0.000	0.000	0.000
F test	4.962	3.840	6.306	6.202	5.563	7.236
Demographics	No	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	No	Yes	Yes	Yes	Yes	Yes

Note: ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. Robust standard errors are clustered at the village leve

Table 3: Robustness tests

VARIABLES	0 < β ≤ 2	0 < β ≤ 1
Present Bias	0.148**	0.111**
	(0.057)	(0.053)
Discount Factor	-0.188**	-0.148**
	(0.075)	(0.069)
Pure Present Bias	-	-
	-	-
Asset Index: Durables	0.103***	0.090***
	(0.031)	(0.033)
Asset Index: Agricultural or Processing Tools	-0.018	-0.003
	(0.036)	(0.042)
Asset Index: Transport	-0.022	-0.035
	(0.029)	(0.030)
Herd Size	0.004	-0.008
	(0.021)	(0.024)
Crop Land Owned - Hectares	-0.020	-0.018
	(0.021)	(0.024)
Pasture/Forest Land Owned - Hectares	-0.007	0.008
	(0.019)	(0.022)
Distance to district HQ (KM)	-0.043	-0.052
	(0.042)	(0.042)
Time to District HQ - Dry Season	0.031	0.030
	(0.048)	(0.053)
Time to District HQ - Wet Season	-0.062**	-0.059*
	(0.027)	(0.030)
Number of Extension Visits	0.039**	0.018

	(0.019)	(0.029)
Village received treatment	0.033	0.030
	(0.026)	(0.027)
Female involved in LS decisions	-0.031	-0.051
	(0.030)	(0.033)
Female involved in raising LS	0.038	0.039
	(0.028)	(0.031)
Internal LOC	0.037	0.043*
	(0.023)	(0.025)
External LOC	-0.021	-0.007
	(0.025)	(0.030)
Trust of fellow villagers	0.008	0.000
	(0.022)	(0.022)
Trust of outsiders	0.013	0.007
	(0.018)	(0.019)
Risk Aversion	0.313***	0.296***
	(0.037)	(0.036)
Observations	456	380
R-squared	0.179	0.155

Note: ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. Robust standard errors are clustered at the village level. Demographic characteristics and district fixed effect are included, but not reported.