

# **Vaccines at Work: Experimental Evidence from a Firm Campaign**

Manuel Hoffmann

Roberto Mosquera

Adrian Chadi

**Online Appendices**

## Online Appendix A

**Table A1 Summary Statistics of Employee Characteristics from the Firm Campaign**

<b>Panel A. Basic Statistics</b>					
	<b>Mean</b>	<b>Median</b>	<b>SD</b>	<b>Minimum</b>	<b>Maximum</b>
Monthly Income (\$)	1,766	1,366.10	1,550.62	318.32	17,387.60
Company Tenure (years)	7.95	6	6.68	0	40
Prop. Women	0.49	0	0.50	0	1
Age (year)	36.6	35	8.37	23	80
Prop. College Education	0.91	1	0.28	0	1
Prop. Having Children	0.52	1	0.50	0	1
Distance to Work (km)	7.62	6.68	5.39	0.17	65.90
Work Unit Size (#)	29.30	18	36.46	1	142
Pre Survey Participation	0.48	0	0.50	0	1
Post Survey Participation	0.36	0	0.48	0	1
Diagnosed Sick	0.66	1	0.47	0	1
Granted a Sick Day	0.37	0	0.48	0	1
Diagnosed Flu Sick	0.11	0	0.32	0	1
Diagnosed Non-Flu Sick	0.36	0	0.48	0	1
Vaccination Take-up	0.17	0	0.38	0	1

<b>Panel B. Distribution of Continuous Variables</b>					
	<b>P10</b>	<b>P25</b>	<b>P50</b>	<b>P75</b>	<b>P90</b>
Monthly Income (\$)	634.67	816.85	1,366.10	2,150	3,383.33
Company Tenure (years)	1	3	6	12	16
Age (year)	27	30	35	41	48
Distance to Work (km)	1.92	3.85	6.68	10.48	14.08
Work Unit Size (#)	4	7	18	30	128

*Note:* This table provides summary statistics in the form of the mean, median, standard deviation (SD), the minimum and maximum for the full sample of bank employees in Panel A. For the continuous variables shown in Panel A, we additionally provide distributional statistics in Panel B via percentiles (from P10 to P90). Distance to work was calculated based on employees' home addresses using a geo-location service and is only available for employees in Quito. The proportion of employees diagnosed sick or granted a sick day corresponds to the period between January 1 and November 7, 2017, before the vaccination campaign. This also applies to flu-related and non-flu-related sickness, both of which refer only to respiratory diseases.

**Table A2 Regression Discontinuity Effects of the Vaccine Price on Campaign Participation**

	Baseline	With Controls	Quito Sample	No Late-Comers
	(1)	(2)	(3)	(4)
Monthly earnings above \$750	0.0590 (0.0730)	0.1738 (0.1533)	0.0655 (0.0786)	0.0400 (0.0722)
N	608	608	461	604

*Note:* Robust standard errors in parentheses. This table presents the local average treatment effects of a price change on vaccination take-up. We report the normalized coefficient at a wage of \$750 and a bandwidth of \$300. Individuals who earn more than \$750 paid \$7.49 for the vaccine, while employees whose wage is below this threshold paid \$4.95. All specifications control for Quito fixed effects. Column 1 presents our main estimates without adding additional controls. In Column 2, we test the robustness of the main estimates controlling for the vaccine's price, income, tenure, division in the company, gender, age, and education level. Column 3 presents the estimates using only employees in Quito. In Column 4, we exclude late-comers who were assigned to vaccinate earlier in the workweek (on Wednesday or Thursday) but went to vaccinate later (on Friday or Saturday). Reducing the bandwidth in steps of \$50 to \$150 does not change the results. \* p<0.1 \*\* p<0.05 \*\*\* p<0.01

**Table A3 Recall Information Statements**

	Heard Altruistic Statement	Heard Selfish Statement
	(1)	(2)
Altruistic Information	-1.5205 (4.9361)	-8.6702** (4.1577)
Selfish Information	-3.8382 (4.9514)	-0.0535 (4.0233)
Saturday	-3.9681 (6.2202)	-2.8515 (5.0108)
Baseline	69.47	76.71
N	378	378

*Note:* Robust standard errors in parentheses. This table presents the effects of the different treatments on measurements of recalling the altruistic and selfish statements. The post-intervention survey collects these measures on a scale from 0 to 100. \* p<0.1 \*\* p<0.05 \*\*\* p<0.01

**Table A4 Vaccination Assignment Day and Actual Day of Campaign Participation**

	Employees	Did not vaccinate	Vaccinated on:			
			Wednesday	Thursday	Friday	Saturday
Assigned to Wednesday	403	326	73		1	3
Assigned to Thursday	298	224		69	1	4
Assigned to Friday	247	215			29	3
Assigned to Saturday	216	198				18
<b>Total</b>	<b>1,164</b>	<b>963</b>	<b>73</b>	<b>69</b>	<b>31</b>	<b>28</b>

*Note:* This table shows for all 1,164 employees when they were assigned to vaccinate during the campaign and when they got vaccinated (if so). Of the bank's 929 employees in Quito, after excluding the call center, 23.5% were assigned to vaccinate on Wednesday, 26.7% to Thursday, 26.6% to Friday, and 23.3% to Saturday. The four days refer to the intervention period from November 8 to 11, 2017.

**Table A5 Heterogeneous Treatment Effects on Campaign Participation**

	<b>Men</b>	<b>Women</b>	<b>Short Distance</b>	<b>Long Distance</b>	<b>No Children</b>	<b>Children</b>
	(1)	(2)	(3)	(4)	(5)	(6)
Altruistic Information	-0.0017 (0.0452)	-0.0508 (0.0429)	-0.0545 (0.0445)	-0.0429 (0.0515)	-0.0163 (0.0421)	-0.0368 (0.0454)
Selfish Information	0.0098 (0.0439)	-0.0166 (0.0451)	-0.0085 (0.0458)	-0.0201 (0.0526)	0.0188 (0.0435)	-0.0253 (0.0452)
Saturday	-0.0883** (0.0413)	-0.0677 (0.0441)	-0.0825** (0.0420)	-0.0972** (0.0485)	-0.0531 (0.0396)	-0.1056** (0.0453)
<b>N</b>	<b>593</b>	<b>571</b>	<b>445</b>	<b>449</b>	<b>556</b>	<b>608</b>

*Note:* This table presents the effect of the different treatments on vaccination take-up for different subgroups in the study's population. Long distance is defined as employees living further than the median sample distance of 6.5 km. All specifications control for Quito fixed effects. Robust standard errors in parentheses.  
\* p<0.1 \*\* p<0.05 \*\*\* p<0.01

**Table A6 Peer Effects Robustness and Alternative Definitions**

	<u>Additional control variables:</u>		
	Baseline	Unit Size	Peer Characteristics
	(1)	(2)	(3)
<i>A.</i>			
Baseline: Workweek Assignment	0.0025*** (0.0008)	0.0024*** (0.0008)	0.0021** (0.0009)
N	1,138	1,138	1,138
<i>B.</i>			
Before-or-Same Day Assignment	0.0017** (0.0008)	0.0019** (0.0007)	0.0016** (0.0008)
N	1,138	1,138	1,138

*Note:* This table presents reduced form results of the proportion of peers assigned to vaccinate during the workweek on individual vaccination across different definitions of the instrument for peer vaccination and different sets of control variables. Panel A presents the results using the baseline definition of the instrumental variable, which is all employees who work in the same unit and were assigned to vaccination in the workweek while controlling for individual assignments to the workweek. Panel B presents the results when switching to an instrument using only exogenous variation in peers who were working in the same unit and were assigned to the same day or before to get vaccinated while controlling for individual assignments to the day of the week. Column 1 shows the baseline results where we control for Quito fixed effects. Column 2 shows the results when we control for the number of employees in each unit. Column 3 shows the results when we control for the number of employees in each unit and peers' age and gender. We always measure the proportion of peers in percentage points. Standard errors (clustered at the unit level) are in parentheses. \* p<0.1 \*\* p<0.05 \*\*\* p<0.01

**Table A7 Potential Mechanisms for Peer Effects**

	Effect of Prop. of Peers Assigned to the Workweek on	Baseline	N
	(1)	(2)	(3)
Beliefs about the Flu, its Vaccine, and Interactions with Coworkers			
Vaccines Effective to Improve Health (1-5)	0.0015 (0.0024)	3.74	378
Talked with coworkers about getting vaccinated (pp)	-0.0008 (0.0013)	0.56	360
Went with coworkers to get vaccinated (pp)	0.0006 (0.0008)	0.13	360
Probability of Getting Healthy Without the Vaccine (0-100)	-0.0655 (0.0474)	44.25	367
Probability of Getting Healthy With the Vaccine (0-100)	0.0282 (0.0524)	56.48	367
Informed about the Flu (0-100)	-0.0295 (0.0541)	69.80	372
Informed about the Flu Vaccine (0-100)	-0.0638 (0.0556)	63.70	372
Afraid of the Flu (0-100)	-0.0394 (0.0693)	37.20	372
Afraid of the Flu Vaccine (0-100)	-0.0219 (0.0705)	24.66	372
Would Get Vaccinated out of the Workplace (pp)	0.0001 (0.0012)	0.61	367
Coworkers Convinced me to get Vaccinated (0-100)	0.0374 (0.0733)	20.60	360
I Convinced my Coworkers to get Vaccinated (0-100)	0.0732 (0.0678)	28.37	360

*Note:* This table presents the reduced form effect of peers assigned to the workweek on a series of outcomes identified by the row headers. The measurement unit of each outcome is in parentheses next to the outcome's name. We measure the proportion of peers assigned to the workweek in percentage points. Thus, the estimates represent the effect of a one percentage point change in the proportion of peers. We define peers as all employees who work in the same unit. All specifications control for Quito fixed effects and individual assignments to the workweek. Column 1 presents estimates, Column 2, the baseline value for each outcome, and Column 3, the sample size. Standard errors (clustered at the unit level) are in parentheses. \* p<0.1 \*\* p<0.05 \*\*\* p<0.01

**Table A8 Cost-Benefit Back-of-the-Envelope Analysis**

<b>Average Statistics for Saturday (Control Group)</b>			
Daily wage			\$60.13
Sick day incidence			0.2736
Wage paid for sick day incidence			\$16.45
Vaccine subsidy			\$5.50

<b>Cost-Benefit Analysis</b>	<b>Worst Case</b>	<b>Average Case</b>	<b>Best Case</b>
Sick day incidence relative to Saturday	0.0830	0.0123	-0.0584
Average sick day incidence	0.3567	0.2859	0.2152
Wage paid for sick day incidence	\$21.45	\$17.19	\$12.94
Wages paid relative to Saturday	-\$5.00	-\$0.74	\$3.51
Wages paid relative to Saturday – vaccine subsidy	-\$10.50	-\$6.24	-\$1.99

*Note:* The table provides a back-of-the-envelope calculation for the costs and benefits of the firm campaign. Panel A shows control group statistics for the average employee. The mean daily wage has been calculated based on the monthly fixed wage divided by 22 workdays. The wage paid for sick day incidence is calculated based on the mean daily wage multiplied by the mean sick day incidence. The mean subsidy arises from the subsidies that the firm provided for individuals during this campaign to reduce the vaccine price. The total price of the vaccine (\$10.00) also includes the cost of the medical team of two nurses administering the vaccine, which means that the subsidies represent the relevant cost for the firm. Panel B shows the calculations for the cost-benefit analysis. The sick day incidence relative to Saturday is the treatment effect from Table 4 Panel B with the worst and best case being the 95% lower and upper confidence interval.

**Table A9 Analysis of Employee Productivity**

	<b>Post-Survey</b>		<b>Swipe-Cards</b>		<b>Duration at Work</b>
	<b>General Productivity</b>	<b>Productivity Post-Intervention</b>	<b>Entry to Work</b>	<b>Exit from Work</b>	
	(1)	(2)	(3)	(4)	(5)
Assigned to the workweek	0.1731 (0.1356)	0.1534 (0.1718)	-0.0958 (0.1962)	-0.2368 (0.2930)	-0.1410 (0.3617)
N	343	343	403	403	403

*Note:* This table presents estimates of the effect of the assignment to the workweek on self-reported measures productivity and duration of the workday. The post-intervention survey collects these self-reported measures on a scale from 0 to 10. The swipe card information corresponds to January and is measured in hours. Robust standard errors in parentheses. \* p<0.1 \*\* p<0.05 \*\*\* p<0.01

**Table A10 Analysis of Flu Diagnoses**

	<b>Correlation</b>	<b>Reduced Form</b>
	(1)	(2)
Assigned to the workweek		0.0045 (0.0155)
Prop. peers assigned to the workweek		-0.0003 (0.0006)
Vaccinated	-0.0254* (0.0151)	
Prop. peers vaccinated	-0.0001 (0.0004)	
N		1,120

*Note:* This table presents estimates of the effects on the probability of being diagnosed sick because of the flu. All specifications control for Quito fixed effects. Column 1 presents results from analyses using information on campaign participation. Column 2 presents the results from analyses using random workweek assignment to get vaccinated. The sample includes only units with two or more employees. Standard errors (clustered at the unit level) are in parentheses. \*  $p < 0.1$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$

**Table A11 Robustness Check for Different Definitions of Flu Diagnoses**

	<b>Narrowest Definition of Flu</b>	<b>Main Definition of Flu</b>	<b>Broadest Definition of Flu</b>
	(1)	(2)	(3)
<i>A. Baseline specification</i>			
Assigned to the workweek	-0.0054 (0.0156)	0.0032 (0.0160)	-0.0151 (0.0196)
N	1,148	1,148	1,148
<i>B. Additional control variables</i>			
Assigned to the workweek	-0.0051 (0.0157)	0.0040 (0.0161)	-0.0115 (0.0192)
N	1,145	1,145	1,145

Note: This table presents robustness checks of the effects of being assigned to the workweek on the probability of being diagnosed sick because of the flu using different definitions. All specifications control for Quito fixed effects. Panel B additionally considers control variables for the vaccine's price, income, tenure, division in the company, gender, age, education level. Robust standard errors in parentheses. Using clustered standard errors at the work unit level yields similar standard errors with no change in statistical significance. \* p<0.1  
\*\* p<0.05 \*\*\* p<0.01

**Table A12 Heterogeneous Campaign Effects on Using an Umbrella**

	<b>Baseline</b>	<b>Coefficient</b>	<b>N</b>
	(1)	(2)	(3)
A. Overall			
How often do you carry an umbrella when it rains	6.85	-1.2280** (0.4855)	359
B. Vaccine Effective			
How often do you carry an umbrella when it rains	7.13	-1.6098*** (0.5639)	257
C. Vaccine Ineffective			
How often do you carry an umbrella when it rains	6.06	-0.2292 (0.9615)	102

*Note:* This table presents estimates of the effect of being assigned to the workweek on instances of carrying an umbrella and heterogeneity with beliefs of vaccine effectiveness splitting beliefs at the median on a Likert-scale of 8/10. Responses are on a scale from 1 (“never”) to 10 (“all the time”). Column 2 presents the reduced form estimates. Column 3 presents the number of individuals who answered the survey. Robust standard errors in parentheses. Using clustered standard errors at the work unit level yields similar standard errors with no loss of statistical significance. \* p<0.1 \*\* p<0.05 \*\*\* p<0.01

**Figure A1 Firm Campaign Treatment Message: Control**



*Note:* The above image portrays the email sent to the control group. Translation: Dear Employee, we are running an influenza vaccination campaign in November. You are eligible for a flu shot on Thursday, November 9, from 8:30 to 11:30. We obtain a discount on the vaccine's price. For you, the price is \$4.95, which will be deducted from your payroll if you choose to get vaccinated. If you have questions, please contact \_\_\_\_\_. Let's get vaccinated!

**Figure A2 Firm Campaign Treatment Message: Opportunity Cost (Saturday)**



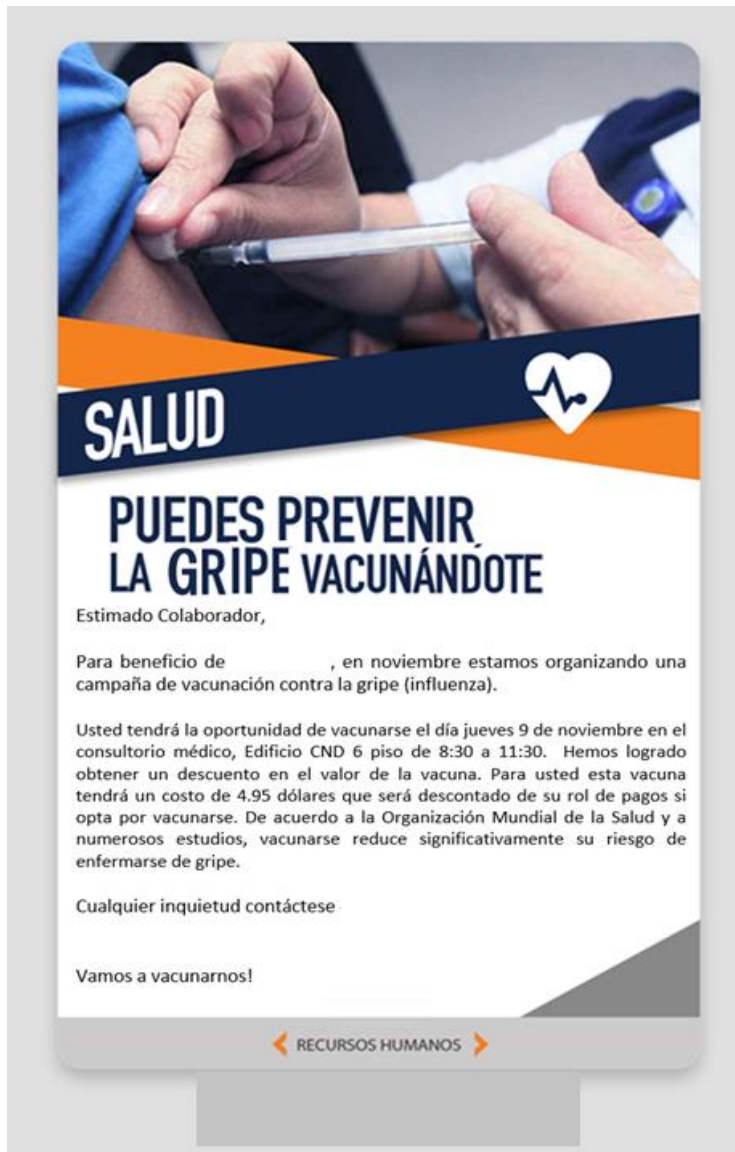
*Note:* The above image portrays the email sent to the “Saturday” treatment group. Translation: Dear Employee, we are running an influenza vaccination campaign in November. You are eligible for a flu shot on Saturday, November 11, from 8:30 to 11:30. We obtain a discount on the vaccine’s price. For you, the price is \$4.95, which will be deducted from your payroll if you choose to get vaccinated. If you have questions, please contact \_\_\_\_\_. Let’s get vaccinated!

**Figure A3 Firm Campaign Treatment Message: Altruism**



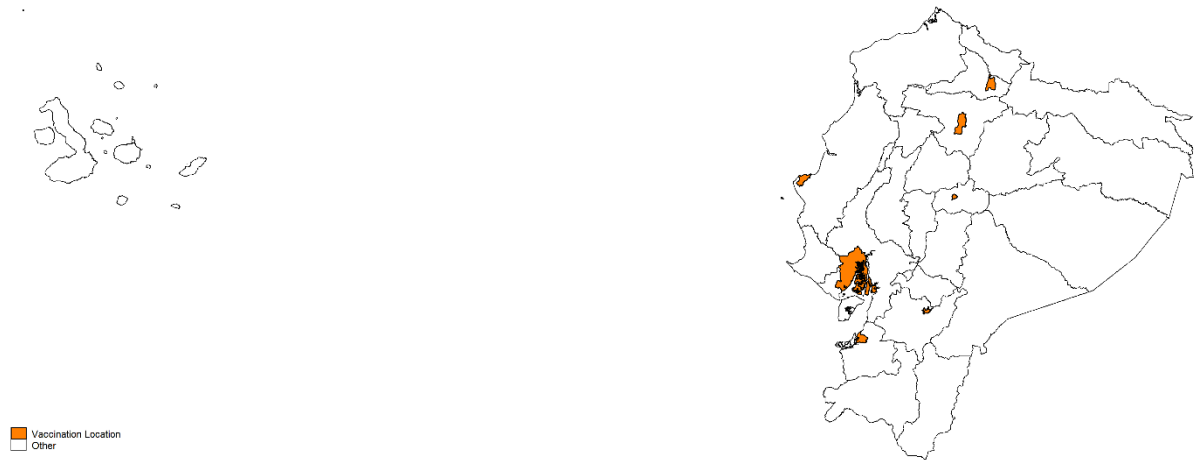
*Note:* The above image portrays the email sent to the “Altruistic Treatment” group. Translation: Dear Employee, we are running an influenza vaccination campaign in November. You are eligible for a flu shot on Thursday, November 9, from 8:30 to 11:30. We obtain a discount on the vaccine’s price. For you, the price is \$4.95, which will be deducted from your payroll if you choose to get vaccinated. Getting vaccinated yourself also protects people around you, including those who are more vulnerable to severe flu illness, like infants, young children, the elderly and people with dangerous health conditions that cannot get vaccinated. If you have questions, please contact \_\_\_\_\_. Let’s get vaccinated!

**Figure A4 Firm Campaign Treatment Message: Selfish**



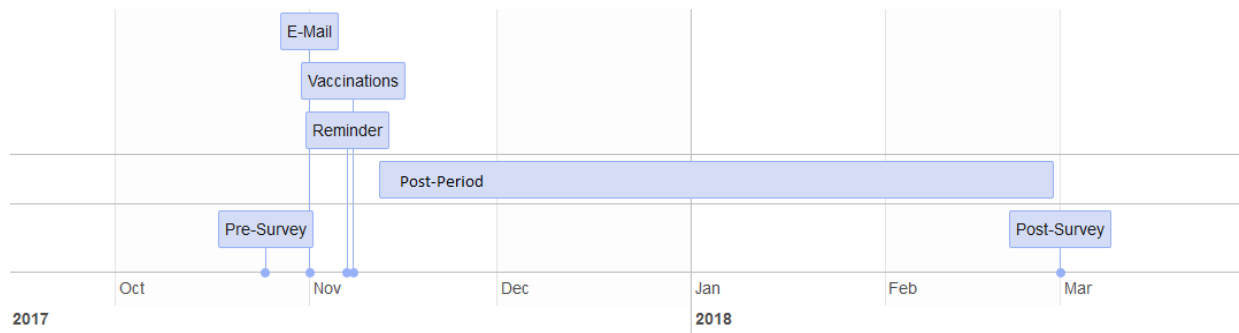
*Note:* The above image portrays the email sent to the “Selfish Treatment” group. Translation: Dear Employee, we are running an influenza vaccination campaign in November. You are eligible for a flu shot on Thursday, November 9, from 8:30 to 11:30. We obtain a discount on the vaccine’s price. For you, the price is \$4.95, which will be deducted from your payroll if you choose to get vaccinated. Vaccination can significantly reduce your risk of getting sick, according to health officials from the World Health Organization and numerous scientific studies. If you have questions, please contact \_\_\_\_\_. Let’s get vaccinated!

**Figure A5 Locations of the Bank in Ecuador**



*Note:* The map contains the locations of the bank in Ecuador (orange), where the firm campaign was implemented.

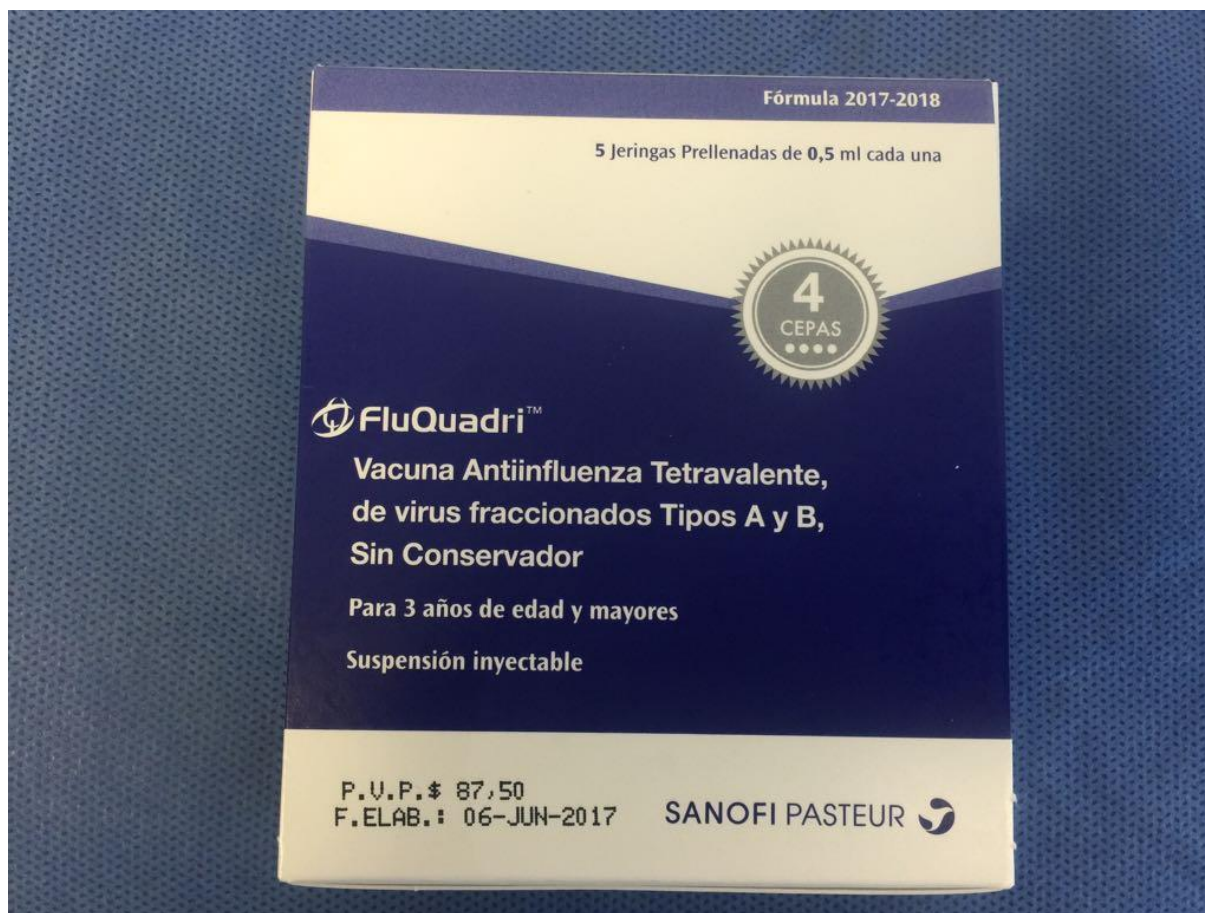
**Figure A6 Timeline of the Firm Campaign**



*Note:* The bank sent out the pre-intervention survey on October 18. The bank sent emails with the different treatments on November 1 using the Human Resources department mail account. It sent a reminder email on November 7. The firm campaign took place between November 8 and November 11. The post-treatment period (Ecuadorian flu season) went from November 13 to March 1. The bank sent the post-intervention survey out during March and April 2018.

**Figure A7 The Firm Campaign's Influenza Vaccine**

---

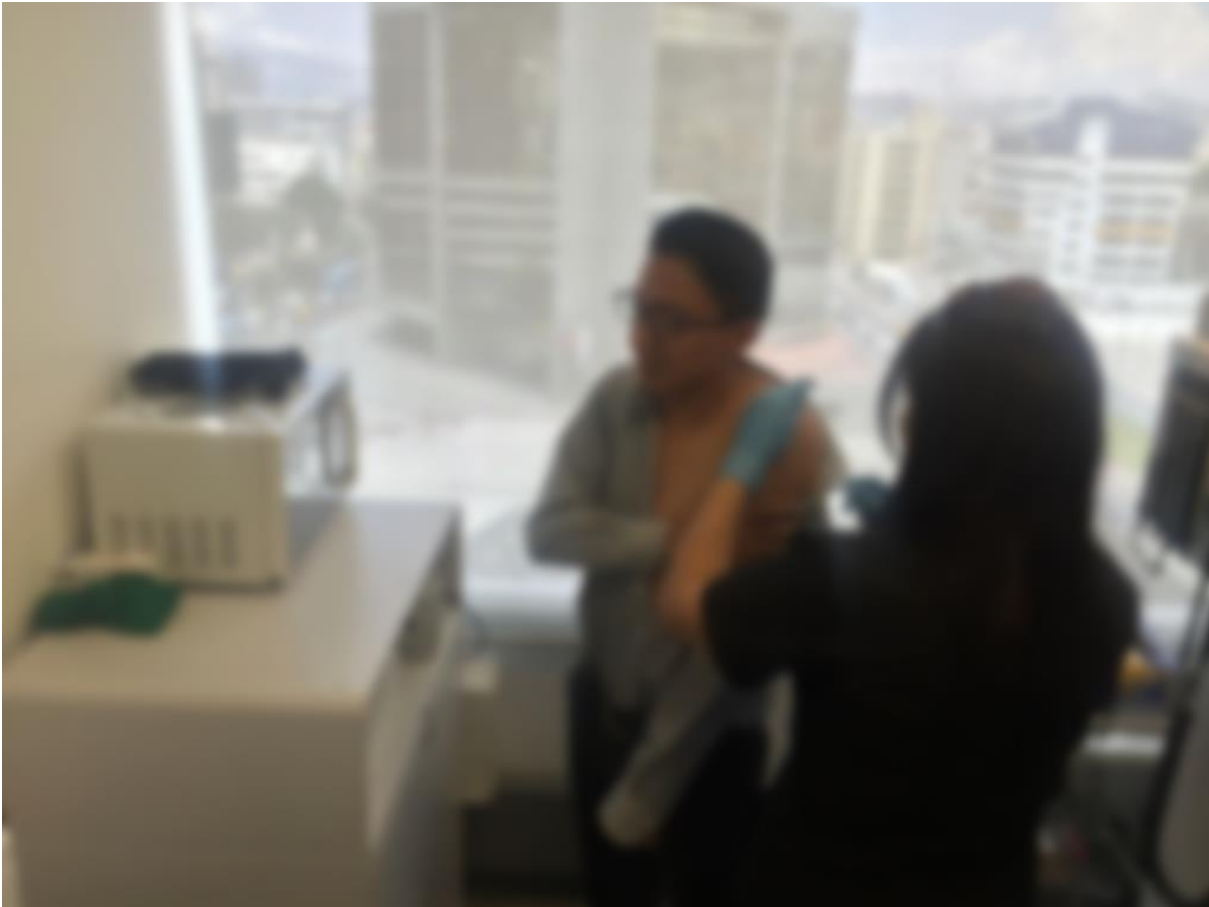


---

*Note:* The above package contains the influenza vaccine used in the firm campaign. According to the manufacturer, this vaccine protects against four strands of the flu, two from type A and two from type B.

**Figure A8 Firm Campaign: Flu Shot in Action**

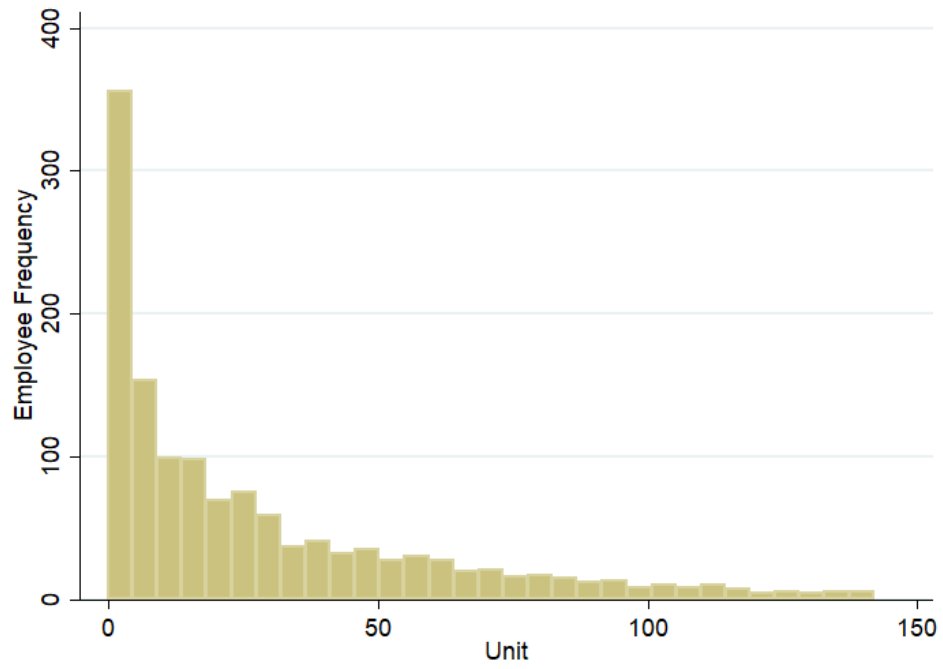
---



---

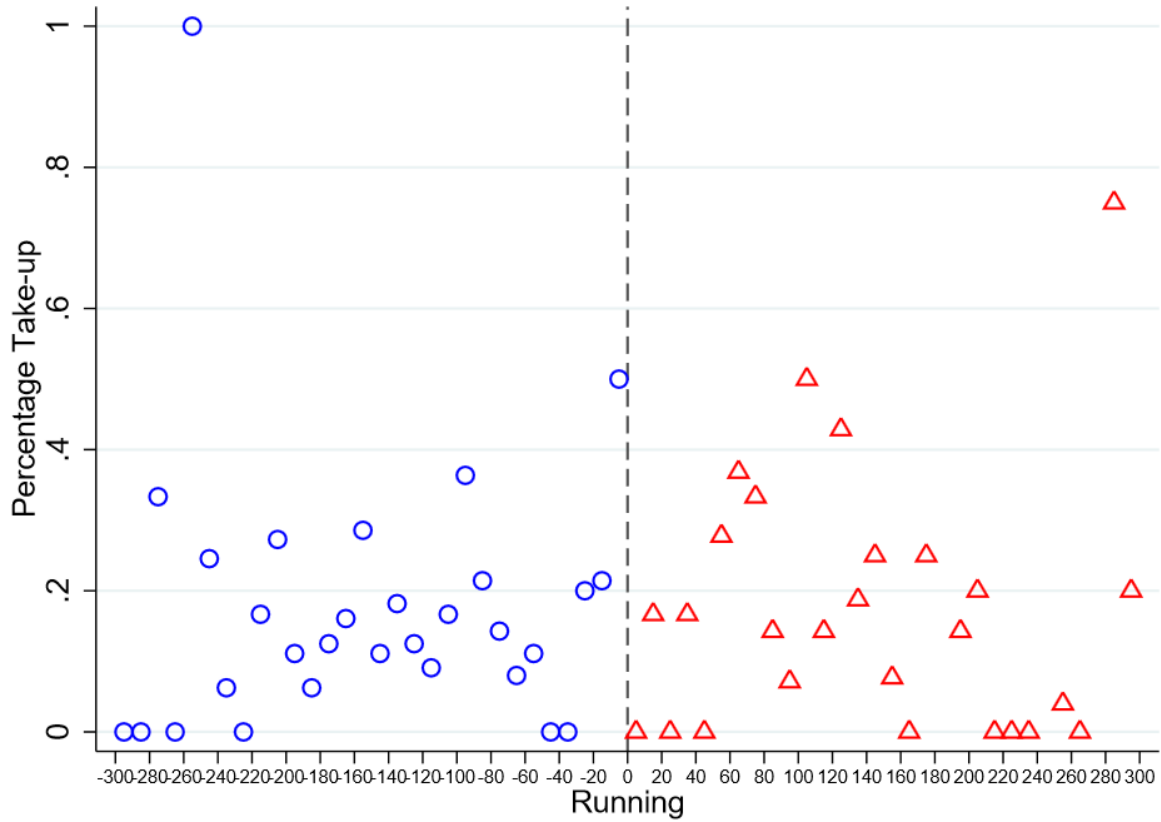
*Note:* Participation in the campaign at the firm.

**Figure A9 Frequency Distribution of Employees in Units**



*Note:* This figure presents the number of employees in each of the 142 units.

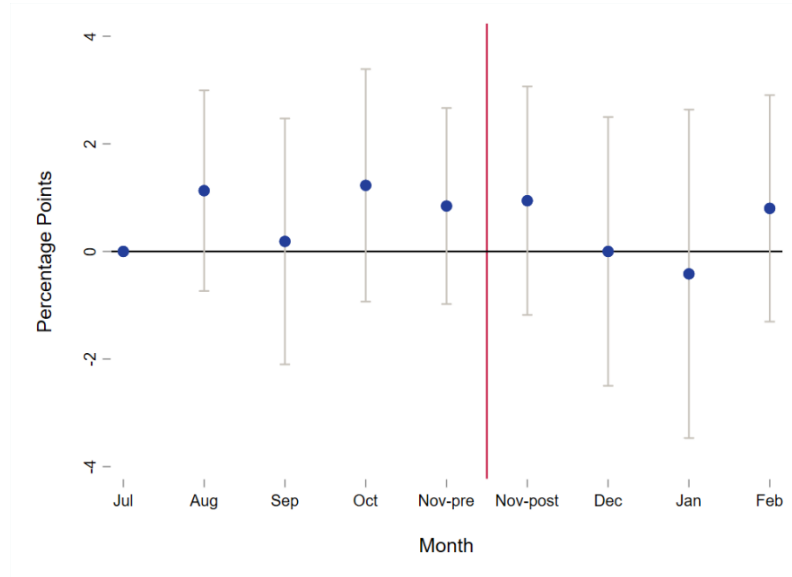
**Figure A10 Firm Campaign Participation around \$750 Wage Threshold**



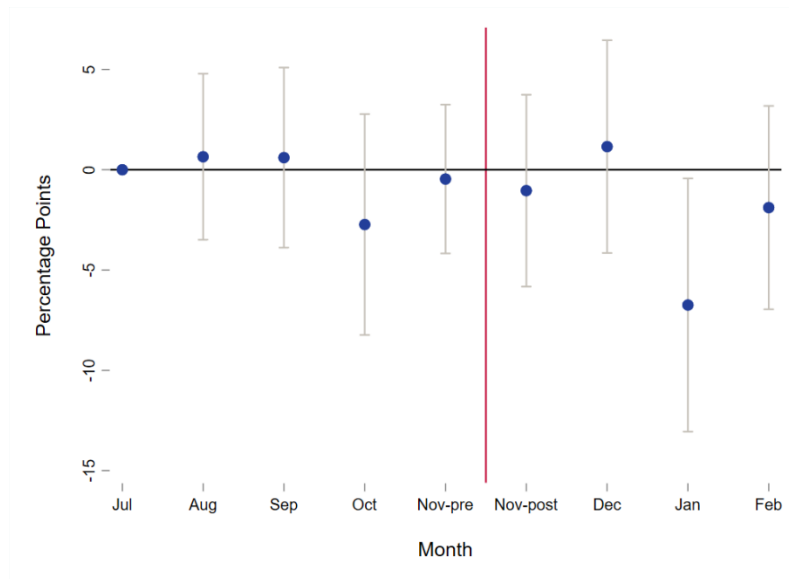
*Note:* This figure presents the evolution of firm campaign participation around the \$750 threshold with a bin size of \$10. Individuals who earn more than \$750 paid \$7.49 for the vaccine, while employees whose wage is below this threshold paid \$4.95.

**Figure A11 Difference in Difference Analysis of Sickness Incidence**

(a) Flu Diagnoses

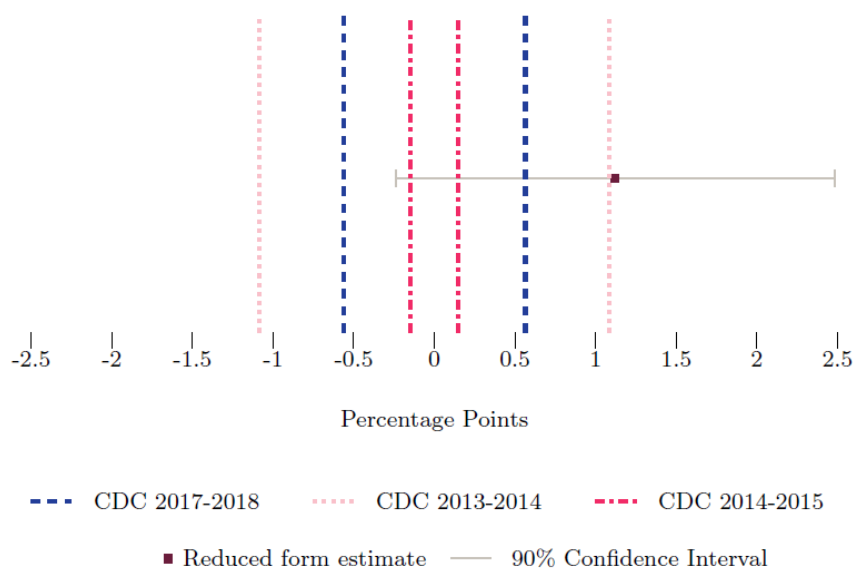


(b) Non-flu Diagnoses



*Note:* This figure presents difference-in-differences estimates of the effect of assignment to the workweek on flu and non-flu diagnoses incidence. Estimates control for individual fixed effects. 95% heteroscedastic robust confidence intervals are shown.

**Figure A12 Equivalence Test for the Effectiveness of the Firm Campaign**



*Note:* This figure presents the estimate of the effect of assignment to the workweek on flu-related sickness absenteeism to adjusted CDC estimates of the effectiveness of the flu vaccine for 2013-2014, 2014-2015, and 2017-2018 seasons.

## **Appendix A1: Background Information on the Study Design**

This appendix chapter describes how our study was conceived and executed. We provide additional details on the background of the experimental intervention and our ex-ante plan, including ideas that we do not discuss in the main body of the paper. In this context, we also point out aspects of our analysis that are more exploratory in nature, which may be of interest given that in 2017, at the time of our intervention, we did not register the design and empirical analysis before starting the data collection (although we registered our study later).

After initiating our cooperation with the Ecuadorian bank where we ran the intervention, we designed our study in 2017. Thanks to this cooperation, we could implement a random encouragement design to study the consequences of a firm-wide vaccination campaign as a novel contribution to the economic analysis of health interventions. For that purpose, it was important to detect significant determinants of vaccination modifiable by us to create exogenous variation in vaccine take-up. A central part of our research objectives has therefore always been the discussion and analysis of what motivates people to get vaccinated, especially since understanding the determinants of vaccination is another important and policy-relevant research aim.

In our pre-intervention discussions with the bank, we identified several potentially relevant determinants of flu vaccination that could enable us to study how campaigns to increase vaccine take-up may or may not affect health outcomes in a firm context. First, we discovered an organizational bottleneck concerning the scheduling of vaccinations, as several days, including Saturday, were necessary to offer an appointment for the entire 1000+ employee workforce. We expected this could make campaign participation more or less attractive for employees whose opportunity costs of vaccination may differ depending on the day of the week. Second, inspired by the fact that vaccination encouragement emails are a routine aspect of our work lives, we exploited that many employees were offered an appointment during the workweek to establish additional within-workweek information treatments in the form of two information nudges, thereby mimicking an intervention often used by employers to encourage employees to vaccinate. To prevent possible contamination across treatments and confounding the effect of information with salience or other behavioral factors, we kept these additional email messages as unobtrusive as possible. Finally, we found out about a third opportunity to induce exogenous variation: Given that health insurance does not cover flu vaccination, the bank was willing to subsidize the vaccine

for its employees. Contrary to the assignment day (modification 1) and email content (modification 2), the firm did not allow us to randomize subsidies across employees, but we could set the wage threshold at which the subsidy of the vaccine changed. This created a textbook case of a regression discontinuity design (RDD) to better understand whether employees' vaccination decisions are sensitive to minor changes in the price of a medical product.<sup>1</sup>

Regarding the determinants of campaign participation, we follow our ex-ante plan closely in the paper as we describe all modifications of the campaign to vary employee vaccination, including those that did not affect behavior significantly. Accordingly, we include a discussion of the RDD approach and the original experimental design with its modification of the email content. What we have kept out of the paper is an even more detailed analysis of why people do (not) get vaccinated. In this context, we enriched our employee surveys with questions on pro-sociality, risk, and time preferences, which we initially thought could inform a discussion of the mechanisms underlying vaccination decisions, especially if we were unable to find significant determinants of vaccination.

Instead, we focus more in the paper on the consequences of campaign participation where we follow our plan closely by exploiting our rich data on health outcomes. This is straightforward as employee health and especially sickness absence are of great relevance from the standpoint of the researcher and economically aligned with the firm interest in recouping a return on its investment. Moreover, we provide a discussion of explanations for the ineffectiveness of the campaign, which contrasted expectations of the firm that paid for it, to enrich the value of our contribution and inform policymakers interested in the outcomes of health campaigns. Part of the discussion is an analysis based on data we collected on purpose, such as survey data on health-related behaviors. Other analyses, such as the one based on doctor visits during the national emergency in early 2018, are exploratory, as we rely on events and information that we could not anticipate. In this part of the paper, we also benefit from using the aggregate share of workweek assignments at the business unit level as a trigger for peer vaccination. This idea came up during our work on the project after we found out that the workweek assignment indeed strongly affected vaccination. By analyzing the effects of peer vaccination at the unit level, we can discuss a possible role of health externalities as a potential explanation for the lack of differences in health between treatment groups and separately complement our analysis of the determinants of campaign participation.

---

<sup>1</sup> In this analysis, we focus on employees for whom the vaccine subsidy varied depending on their wage. This excludes employees who were targeted by the previous year's campaign and for whom the bank decided to pay a full subsidy.

## **Appendix A2: Additional Analyses of Flu-Related Sickness Outcomes**

In this appendix, we describe our analyses of data on medical diagnoses to learn more about possible effects of participation in the firm campaign. A correlation analysis presented in Column 1 of Table A8 suggests that individual vaccination goes along with a lower probability of being diagnosed with the flu. However, the analysis in Column 2 based on our main approach reveals a positive effect of being assigned to the workweek on the probability of being diagnosed with the flu, which is close to zero and insignificant. This suggests that the campaign was ineffective in decreasing the probability of having the flu. Furthermore, the estimates in Columns 1 and 2 show no effects of the proportion of vaccinated peers on the probability of being diagnosed with the flu.

As can be seen in Table A9, our main finding is robust to the use of a broader and a narrower definition of flu-related illness as well as to the inclusion of control variables (gender, age, tenure, and income). In another check, we again find no significant impacts when controlling for individual fixed effects using a month-based difference-in-difference approach (Figure A11).

To evaluate whether we can rule out meaningful effects of the firm vaccination campaign on flu-related illness, we implement an equivalence test based on two one-sided hypothesis tests (Hartman & Hidalgo, 2018; King et al., 2000; Lakens, 2017; Rainey, 2014). The equivalence test has two parts. First, we must define what constitutes a meaningful effect of vaccination. This value comprises two thresholds to evaluate whether the estimates rule out meaningful effects. To define this value, we use flu vaccine effectiveness estimates from CDC data (CDC, 2019). These estimates come from observational studies on flu hospitalizations and, hence, might be biased because of endogeneity issues. Also, hospitalizations almost exclusively occur to the very old and are less likely for the average working-age person. While the CDC numbers may thus be seen as an overestimate, they constitute the criteria that policymakers use to assess vaccine effectiveness.

In the following exercise, we compare the CDC data with our evidence from the firm campaign by focusing on the probability of being granted a sick day due to the flu. While the CDC provides data about the percentage effectiveness of the vaccine, we require percentage point changes for the equivalence test. These percentage changes come from CDC cross-tabulations on the number of individuals vaccinated and not vaccinated and the number of individuals getting sick with the flu and not getting sick with the flu. The CDC further adjusts these estimates to consider demographic characteristics that affect natural immunity to the flu and thus result in larger estimates; therefore,

the reported cross-tabulation percentages are a conservative lower bound of the CDC estimates. According to the CDC, for working adults, the 2013–2014 vaccine had the highest effectiveness (reducing hospitalizations by 16 percentage points), the 2014–2015 vaccine had the lowest effectiveness (reducing hospitalizations by only 2.2 percentage points), and the 2017–2018 vaccine’s effectiveness (the period of the campaign for the current research) fell in between those estimates (reducing hospitalizations by 8.4 percentage points). To compare these values with our estimates from the firm campaign, we multiply the CDC effectiveness values by the relevant first stage of the workweek assignment effect on vaccine take-up. This calculation yields reference values of –1.1 percentage points, –0.1 percentage point, and –0.6 percentage points, respectively.

In a second step, we test whether the effect of the workweek assignment on flu-related sickness absence is smaller than each reference value (–1.1, –0.1, –0.6) and higher than the absolute values of the reference values (1.1, 0.1, 0.6). This is equivalent to comparing both the reference values and their respective absolute values with the 90-percent confidence interval of the estimated effect (Lakens, 2017; Rainey, 2014). If the 90-percent confidence interval lies between the reference and its absolute value, then the estimated effects are consistent only with meaningless effects. If the confidence interval falls outside this value range, we cannot rule out meaningful effects in the direction in which the confidence interval overlaps the boundary.

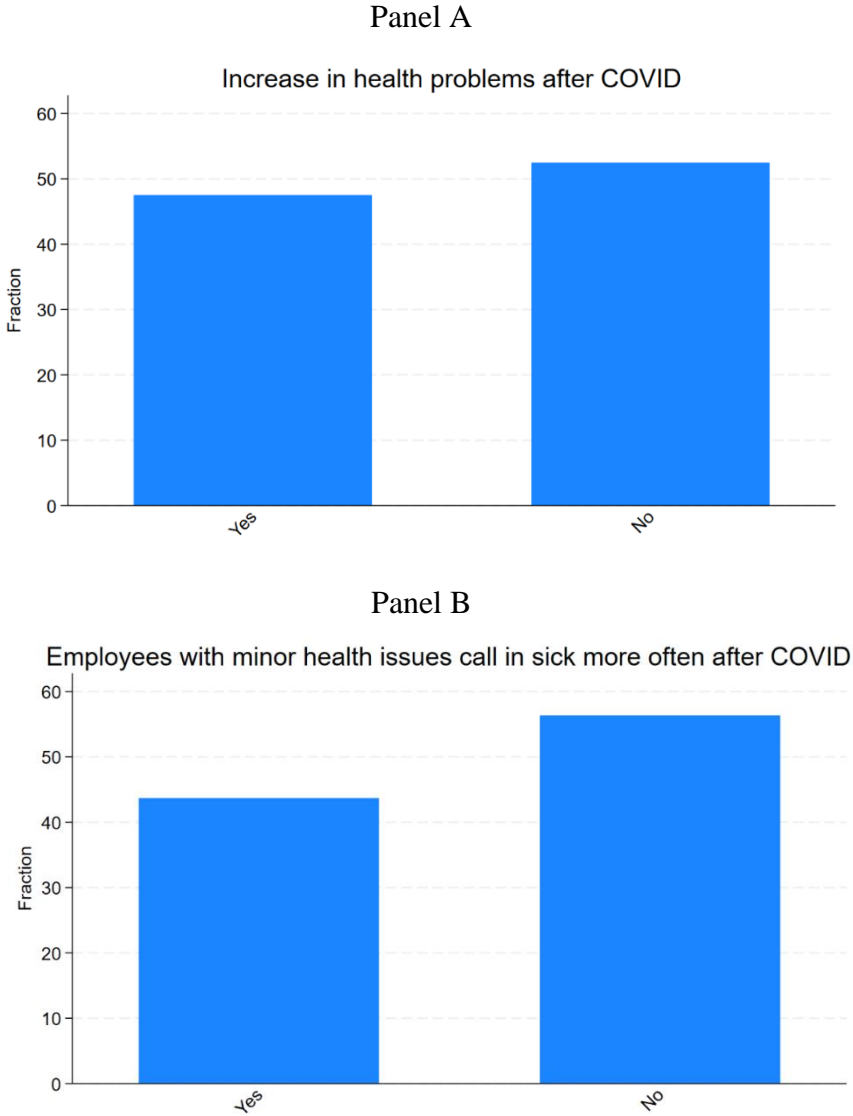
Figure A12 presents the comparisons. We can reject the CDC’s vaccine effectiveness estimate for the best season (2013–2014) and that for our campaign season (2017–2018). Our estimated effect is consistent with the effectiveness estimate for 2014–2015 (the season with the lowest effectiveness). These results imply that we can rule out meaningful health benefits of the firm vaccination campaign based on public health figures provided to policymakers.

## References

- CDC (2019). Past Seasons Vaccine Effectiveness Estimates. Center for Disease Control. Accessed July 28, 2019. Source: <https://www.cdc.gov/flu/vaccines-work/past-seasons-estimates.html>.
- Hartman, E., & Hidalgo, F. D. (2018). An equivalence approach to balance and placebo tests. *American Journal of Political Science*, 62(4), 1000-1013.
- King, G., Tomz, M., & Wittenberg, J. (2000). Making the Most of Statistical Analyses: Improving Interpretation and Presentation. *American Journal of Political Science*, 347-361.
- Lakens, D. (2017). Equivalence tests: a practical primer for t tests, correlations, and meta-analyses. *Social Psychological and Personality Science*, 8(4), 355-362.
- Rainey, C. (2014). Arguing for a negligible effect. *American Journal of Political Science*, 58(4), 1083-1091.

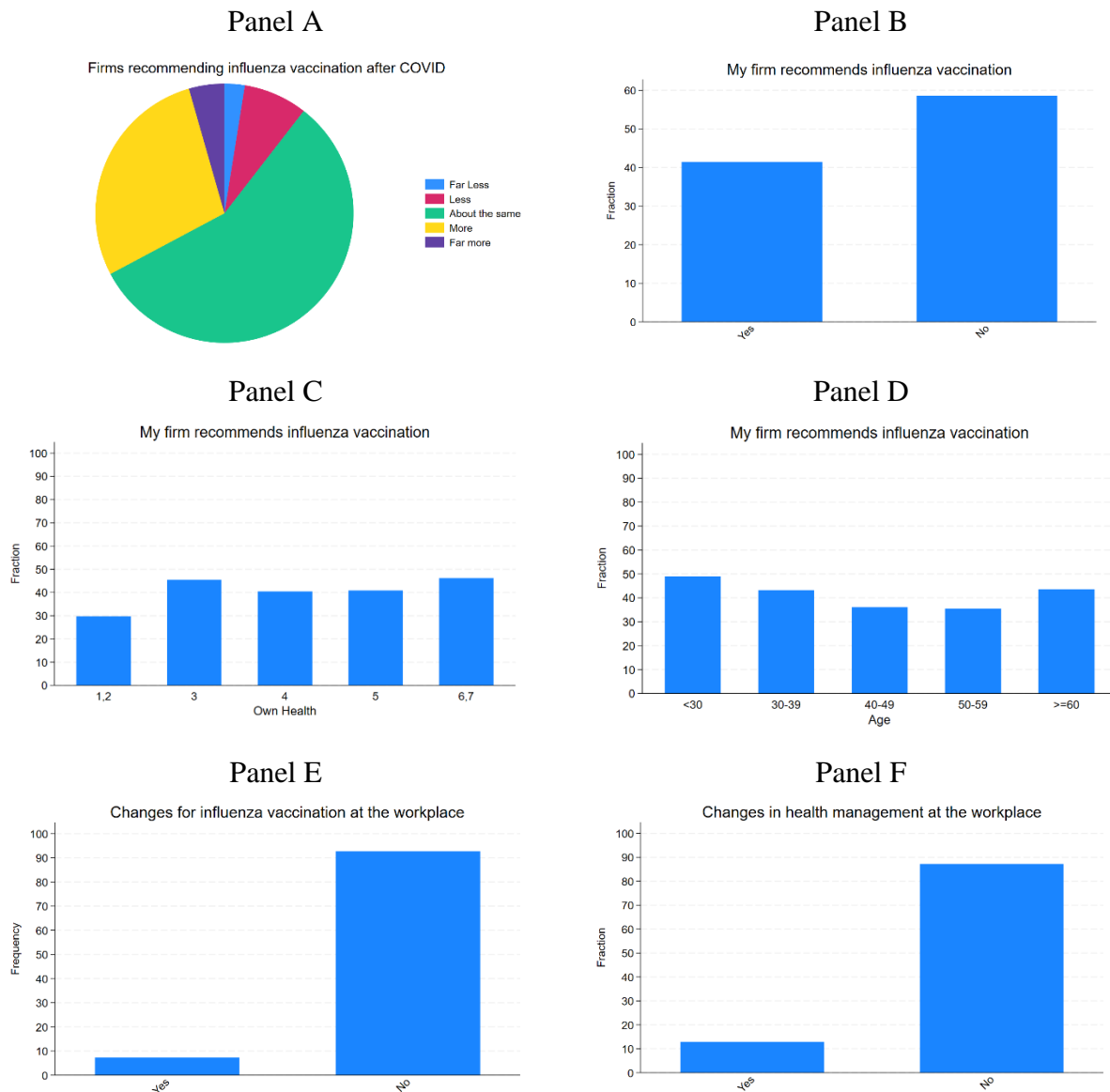
# Online Appendix B

## Figure B1. Survey Questions on Health and Sickness Absence



*Note:* This figure presents the fraction of individual responses to questions 1 and 2 in our survey on changes in employee health and health management challenges in the post-COVID era. The question for Panel A is “Do you think that employees in 2024 have more health problems than before the COVID pandemic?” The question for Panel B is “Do you think that employees with minor health issues call in sick more often in 2024 than before the COVID pandemic?”

**Figure B2. Survey Questions on Workplace Health Management**



*Note:* This figure presents the fraction of individual responses to questions 3 to 6 in our survey on changes in employee health and health management challenges in the post-COVID era. The question for Panel A is “Do you think that compared to the time before the COVID pandemic, more or fewer companies today recommend that their employees get a flu vaccination as part of their health management?” The question for Panel B is “Does your employer recommend getting a flu vaccination?” In Panels C and D, we show the share of “Yes” answers to the question in Panel B (regarding the employer’s recommendation to get a flu vaccination) across respondents’ health status and age categories. To capture their own health status, the respondents indicate whether they are “healthy” on a scale from 1 (“does not apply at all”) to 7 (“does apply completely”). The question for Panel E is “Has your employer’s workplace health management regarding flu vaccinations changed compared to the time before the COVID pandemic?” The question for Panel F is “Has your employer’s workplace health management generally changed compared to the time before the COVID pandemic?”

## **Appendix B: Workplace Health Management Survey (2024)**

This appendix examines the extent to which firms may face new health management challenges in the post-COVID era and the role of flu vaccinations in this context. A possible reason to expect such changes are increases in employee absenteeism observed in some countries in the wake of the pandemic. One example is the country of Germany where absence rates increased from around 11 to 15 sick leave days in 2022, the year the country lifted most of its pandemic restrictions. Germany's federal statistical office provides the official statistics and refers to "major waves of influenza and colds" as possible explanation for the high level of sickness absence. More recent findings based on analyses of healthcare insurance data show that absence rates in Germany remain high since then and media reports point to a role of respiratory problems in this context.<sup>2</sup>

For managers and policymakers, such statistics seem to further underscore how important policies and managerial considerations today are to prevent diseases in the working-age population. On the one hand, one could argue that companies now have even stronger motives to think of ways to address ill-health in employees, especially in relation to respiratory problems, so that evidence-based analyses of economic costs and benefits of health campaigns such as in our paper appear even more relevant than before. On the other hand, one could ask if there are changes in the role of health interventions, especially flu vaccination campaigns, as one of the most common policies preferred by companies to tackle potential health problems in their workforces.

To empirically assess the possibility of new health management challenges for companies, we conducted a survey with individuals from Germany, a country with a widely reported rise in sickness absence post-COVID. We conceived a module with several survey questions that we integrated into an ongoing survey project conducted online in the summer of 2024. Our sample includes 1,113 quasi-representative observations which were drawn from the adult population of Germany along the criteria of gender, age, and educational levels.

We designed the survey questions to address two major issues. First, it is an open question whether there was an increase in health problems that could have led to the reported jump in absenteeism after the pandemic. While this phenomenon could be driven by increases in actual

---

<sup>2</sup> The internet sources can be found here: [https://www.destatis.de/EN/Themes/Labour/Labour-Market/Quality-Employment/Dimension2/2\\_3\\_StaffSickLeave.html](https://www.destatis.de/EN/Themes/Labour/Labour-Market/Quality-Employment/Dimension2/2_3_StaffSickLeave.html) (website of Germany's federal statistical office about sick leave), <https://www.spiegel.de/wirtschaft/service/arbeitsmarkt-und-krankenstand-deutschland-kaempft-mit-anhaltend-hohen-fehlzeiten-a-a962ac9b-75d5-4d93-838c-5487b59a1f08> (example of news coverage in the German media) and <https://www.ft.com/content/8e7bc450-7dc7-45c2-82ed-99ab2a8c4952> (example of international news coverage).

health problems, it could also be due to behavioral changes, such as employees calling in sick more often when they have mild health problems, similar to the discussion in our paper on employee behavior. Second, assuming that there are noticeable changes in sickness absence due to changes in employee health, we asked questions to identify possible implications for health management in companies. In particular, we were interested in whether there are changes in the role of firm-wide health policies today, compared to before 2020, also with respect to flu vaccination.

As the first result from our survey, Figure B1 Panel A shows that slightly more than half of the respondents (52%) do not agree that employees are sick more often today compared to before COVID. This is interesting given the above-mentioned and widely reported statistics on sick leave, which suggest increased health problems among working-age people in the wake of the pandemic.<sup>3</sup> Second, Figure B1 Panel B shows that a relatively large share of respondents (43%) believe that employees call in sick more often today if they have mild health problems.<sup>4</sup> Arguably, this behavioral finding can help explain the increase in absenteeism reported by German health institutions if some employees may not be sick more often but make different behavioral choices.

In Figure B2, we illustrate the evidence from our questions on the health management in a company context, with a focus on flu vaccination. Panel A provides little evidence of perceived changes in the likelihood of employers recommending flu vaccines to their employees as part of their health management, which, if anything, seems to play a bigger role nowadays as it did before COVID. According to Panel B, the share of employers actually recommending flu vaccination to their workforces is quite substantial (40%), considering that there are millions of different companies in Germany.<sup>5</sup> Notably, this share is quite similar across different groups of people in terms of self-assessed health and age (Panels C and D). Finally, we asked questions about perceived changes in the health management of firms. This idea receives almost no support, as the vast majority (93%) do not report changes in the health management concerning flu vaccinations at work (Panel E), and only a small share of respondents (12%) report that workplace health management has generally changed compared to the time before the COVID pandemic (Panel F).

---

<sup>3</sup> When we inspect the text comments by respondents who do agree with the idea of increased health problems, we obtain no clear picture. Their responses refer to many different things, including a weakened immune system, which might be consistent with the idea of increased susceptibility towards respiratory diseases.

<sup>4</sup> As an example of a textbox comment to explain the increase in shirking behavior, a respondent stated that “everything is blamed on COVID” nowadays. Another respondent argued that it is “easier to get sick leave” post-COVID.

<sup>5</sup> We can also look at textbox comments by those respondents who reported that their employer does not provide a recommendation. Accordingly, some of the reasons given are employer indifference, lack of trust, and cost concerns.