Vaccination and Health Behaviour: Evidence from a Flu Vaccination Program in France

Clémentine Garrouste[1], Arthur Juet[1] and Anne-Laure Samson[2]

[1]Université Paris-Dauphine, PSL Research University, LEDa-LEGOS;
[2]LEM, Université de Lille

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Research Question

- Every year, influenza viruses cause up to 5 million cases of severe illness, and 650,000 respiratory deaths worldwide (US-CDC, WHO, 2017).
  - In France, between 2 and 6 million people are affected, with an average of 10,000 deaths per year (Santé Publique France, 2019)
- High-risk individuals: **the elderly**
  - 90% of influenza-associated pneumonia and influenza deaths occurred among persons aged $\geq$65 yo (Thompson et al., 2009).
  - increasingly ageing population $\rightarrow \uparrow$ number of deaths from the flu
- Vaccination, if both existing and effective, is the best way to reduce the risk of infection without influencing social interactions.

Research Question

- WHO recommends that 75% of the elderly have an influenza vaccination.
- In France, the flu vaccine is free of charge for individuals aged 65 and over.
- We investigate
  - the effects of this flu vaccination program on the vaccination adherence.
  - the heterogeneity of the impact across gender, income, education, health behaviour and risk aversion.

Literature

- Previous studies have highlighted the different effects of a vaccination campaign:
  - **Information campaigns and mandatory vaccination campaigns are effective** in raising vaccination rates of the targeted disease for the targeted people (Lawler, 2017; Chang, 2016; Hirani, 2021).
  - **Answer to monetary incentives** (Brilli et al., 2020; Bouckaert et al., 2020; Garrouste, Juet and Samson, 2021).
  - **Unexpected consequences and spillovers** (Bouckaert et al., 2020; Brilli et al., 2020; Carpenter and Lawler, 2019; Bütikofer and Salvanes, 2020).
- Determinants of flu vaccination decisions:
  - Individual characteristics (Nagata et al., 2013)
  - Monetary and non-monetary effects (Bronchetti et al., 2015; Mullahy, 1999)

Literature

- **Individuals with health risk behaviour are more likely to develop severe forms of influenza** $\rightarrow$ their individual benefit for vaccination is higher.
- Chronic alcohol consumption and smoking $\uparrow$ the risk of severe disease and death from influenza infections (Finklea et al., 1969; Murin and Bilello, 2005; Meyerholz et al., 2008).
- Obesity also $\uparrow$ this risk,
  - especially for older individuals (Napolitano et al., 2009)
  - $\uparrow$ the duration of the disease (Maier et al., 2018)
- This is a public policy issue as the non-adhesion is harmful for individuals themselves, as well as for the whole population.

Literature

- The mechanisms in play: if we find heterogeneous responses to the vaccination campaign, this may be explained by risk aversion differences among the population.
- Anderson and Mellor (2008) find that risk aversion is negatively and significantly associated with health behaviour, i.e. smoking, heavy drinking, being overweight and obese.
- Risk averse individuals may be more or less reactive to vaccination campaigns // risk takers.

Contribution

- We adopt a regression discontinuity strategy around the age threshold to measure the effects of the program on the vaccination adherence.
- We also investigate the heterogeneity of the impact across gender, income, education, **health behaviour and risk aversion level**.
- Results
  - Eligibility for free vaccination has a positive effect on the probability of being vaccinated at the age threshold (+10 pp).
  - The effect on the vaccination adherence is driven by individuals with healthy behaviour and risk averse individuals
  - while the vaccination program has no effect for those with health risk behaviour and the risk-takers.

The French Influenza Vaccination Program

- Information campaign on TV, radio, leaflets...
- All individuals considered to be at risk have access to the vaccine free of charge:
  - 65 and over
  - people with chronic illness
  - immuno-deficient people
  - Pregnant women
  - People suffering from obesity (BMI $\geq 40 kg/m^2$)
  - The close circle of infants under 6 months

$\Rightarrow$ A vaccination invitation is sent to individuals 65 or older and people with a chronic illness between September and October

$\Rightarrow$ Low-risk individuals have to pay approximately 9 euros in all

Empirical Strategy

- **RDD**: our identifying strategy exploits the discontinuity in the probability of eligibility at the age of 65.
- We first measure the impact of the age threshold (65 yo) on the eligibility awareness. We use local linear regressions to compare individuals with similar characteristics on either side of the threshold.

$$R_i = \beta_0 + \beta_1 \mathbb{1}_{A_i \geq 65} + \beta_2 \mathbb{1}_{A_i \geq 65} \times f(A_i - 65) + \beta_3 \mathbb{1}_{A_i < 65} \times f(A_i - 65) + \nu_i$$

- R_i equals 1 if the individual reports having received the vaccination invitation at home, 0 otherwise.
- A_i is the running variable, i.e. the age of the individuals
- β_1 identifies the causal effect of the vaccination campaign on the awareness.

Empirical Strategy

- Then, we measure the impact of being above age 65 on the vaccination rate.

$$V_i = \alpha_0 + \alpha_1 \mathbb{1}_{A_i \geq 65} + \alpha_2 \mathbb{1}_{A_i \geq 65} \times f(A_i - 65) + \alpha_3 \mathbb{1}_{A_i < 65} \times f(A_i - 65) + \epsilon_i$$

  V_i is equal to 1 if the individual i is vaccinated against seasonal influenza, 0 otherwise.

- α_1 identifies:
  - the causal effect of the *free vaccination scheme*
  - together with the causal effect of the *communication campaign*

Data

- The 2014 Health and Social Protection Survey (ESPS) collected by the Institute for Research and Documentation in Health Economics (IRDES)
- Representative of the French population
- The data set contains individual information concerning:
  - socio-demographic characteristics
  - vaccination behaviour and invitation
  - health behaviour (alcohol and tobacco consumption, diet and physical activity)
  - risk aversion
- **Treated**: Individuals $\geq$ 65 yo $\Rightarrow$ **eligible for free vaccination on the age criteria**.
- **Non-treated**: Individuals $\leq$ 64 yo.
- Initial sample: N=15,759 individuals
  - individuals who are between 61 and 68 (bandwidth of 48 months around the 65 years old threshold), N=2,068

Graphical Evidence

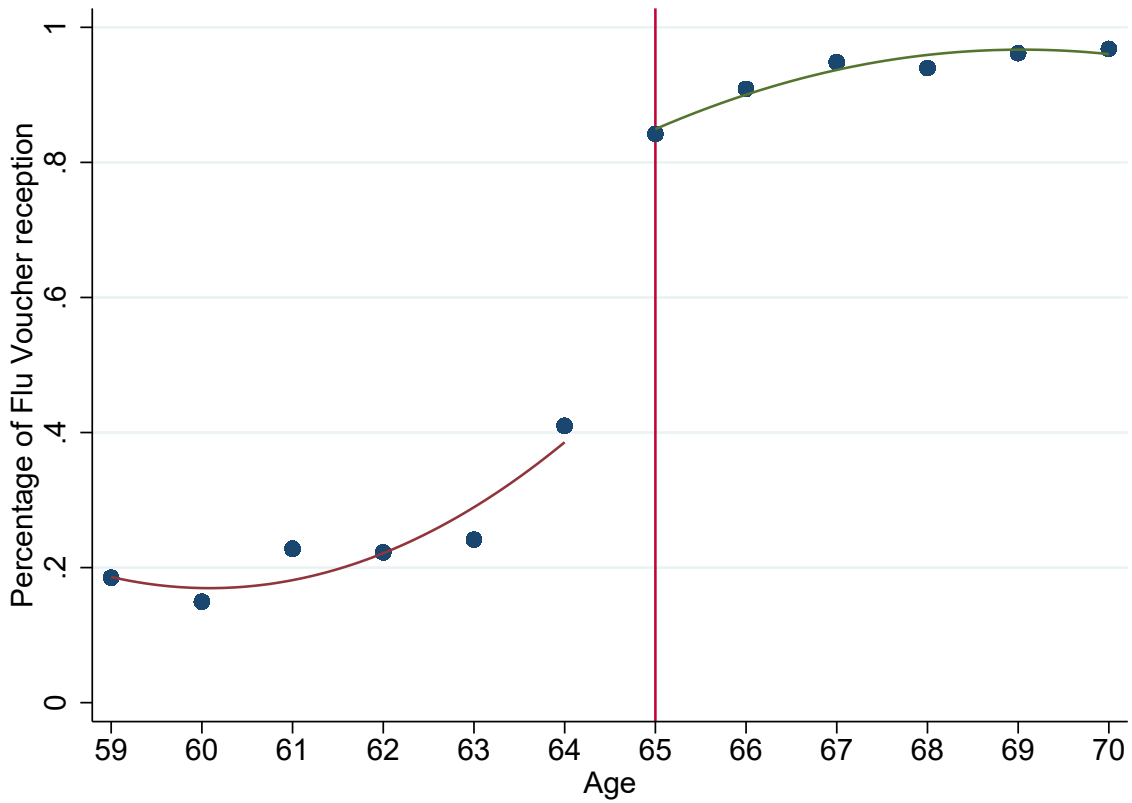


Figure 1: Flu vaccination invitation rate by age

Graphical Evidence

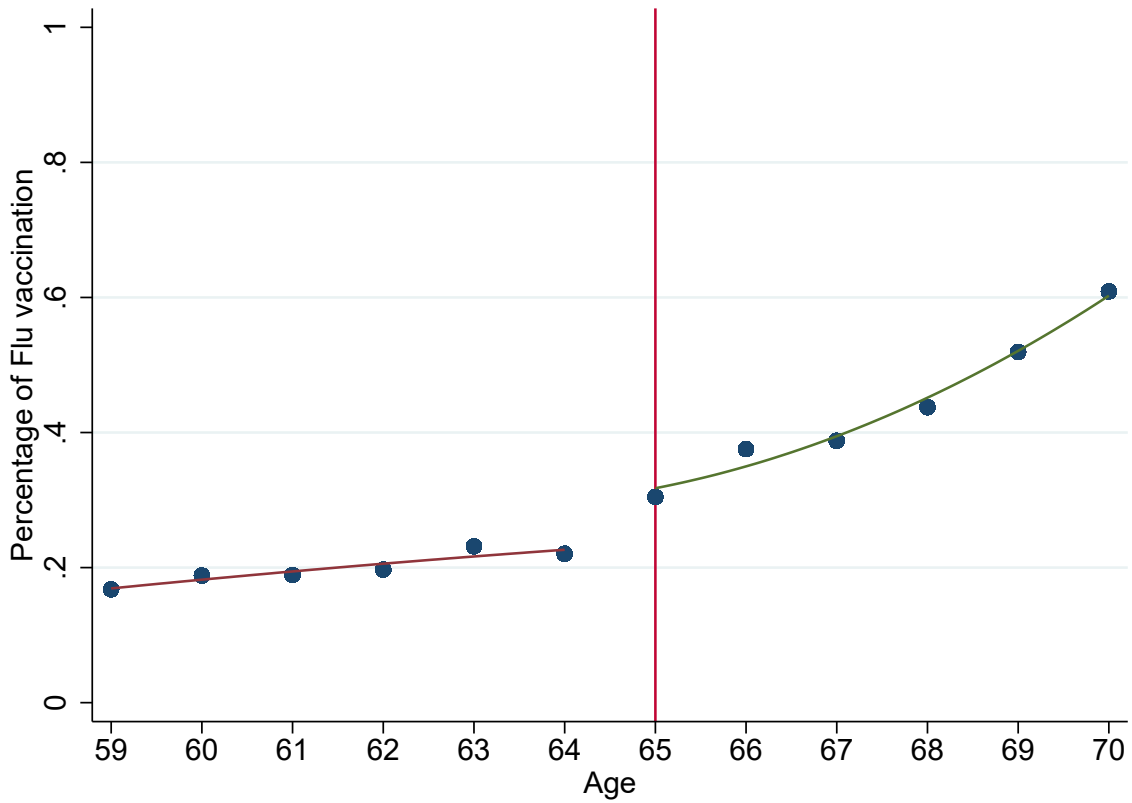


Figure 2: Flu vaccination rate by age

Identification Assumptions

- **Identification assumption**: individuals on both sides of the discontinuity threshold do not differ in any other observable or unobservable characteristics.
- This implies that there is no other policy change at the 65 y.o. threshold.
- However, age 65 may also coincide with life changes, i.e. increasing probability of retiring
  $\rightarrow$ the estimated effect on vaccination adherence could also be attributed to leaving the job market.

Identification Assumptions

- Change in labour force participation

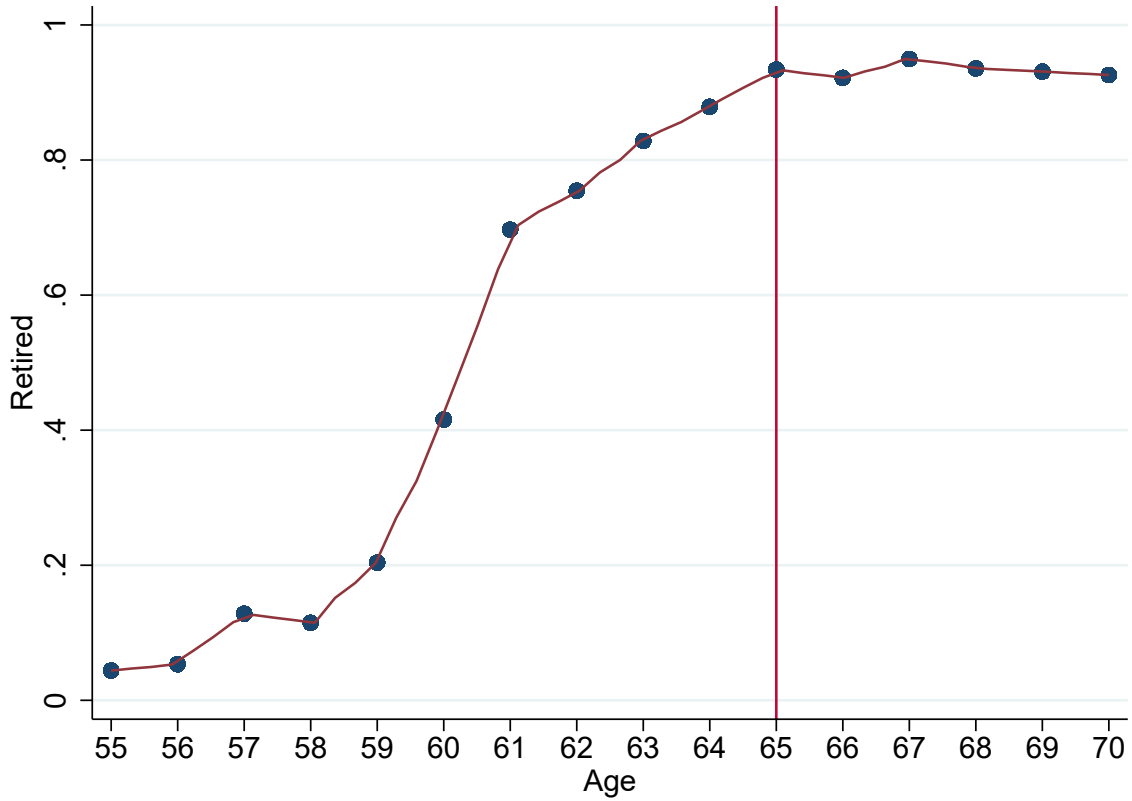


Figure 3: Percentage of pensioner by age

Identification Assumptions

- There is no significant increase in the probability of being vaccinated at 60, 61, 62, 63 or 64 years old. It is thus likely that our estimates are not affected by changes in employment status.
- We also test other observable characteristics of the individuals do not change discontinuously at the cutoff. Continuity of the observable characteristics at the threshold
- No manipulation of the running variable (McCrary, 2008)
- **Individuals with chronic illnesses or obesity are eligible for free vaccination even if they are under the age threshold of 65.**
- **Placebo test**: Since they are eligible regardless of their age, we should not observe any change in the probability of being vaccinated at 65: coeff=-0.02 (se: 0.08)

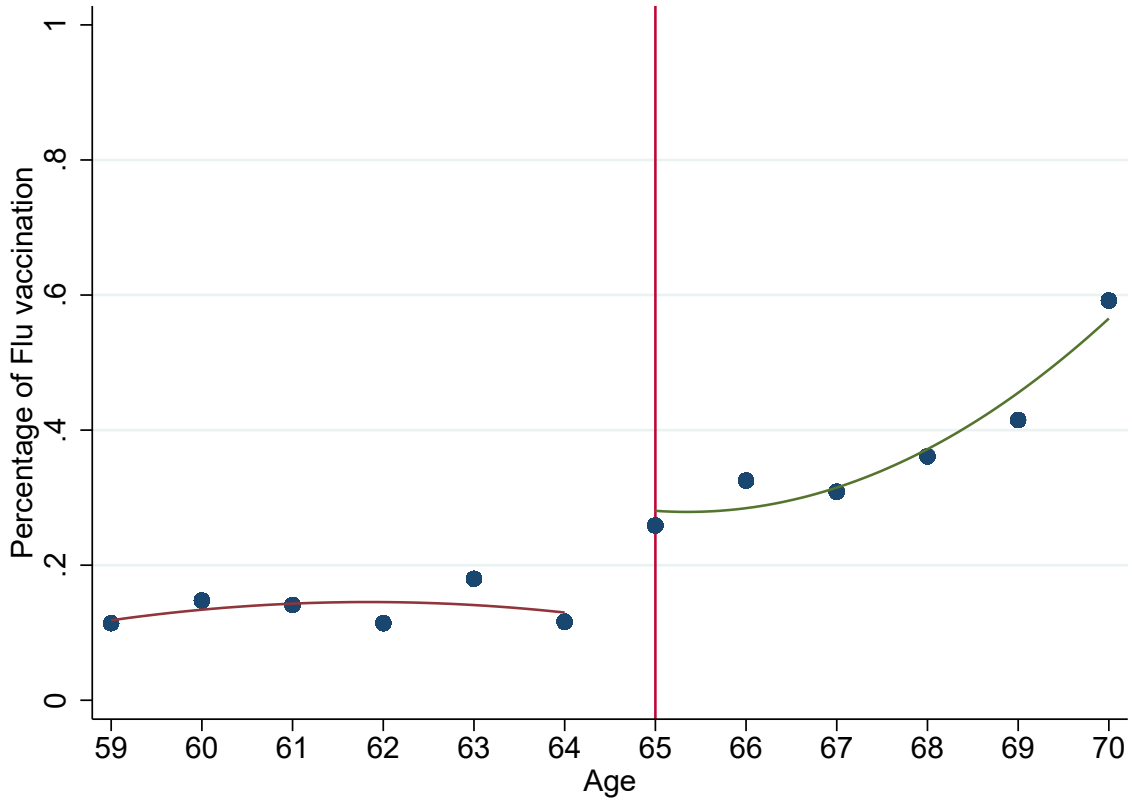


Figure 4: Flu vaccination rate among people without health problems

Main Results

RDD estimates of vaccination invitation reception and vaccination up-take (bw=48 months)

	Whole Sample		**Non-eligible before 65**	
	Vacc. Invite	Vacc. up-take	Vacc. Invite	Vacc. up-take
	(1)	(2)	(3)	(4)
$\mathbb{1}_{A_i \geq 65}$	0.46***	0.07*	0.59***	0.10**
se	(0.04)	(0.04)	(0.04)	(0.05)
R^2	0.43	0.03	0.55	0.05
N	2,046	1,981	1,210	1,177

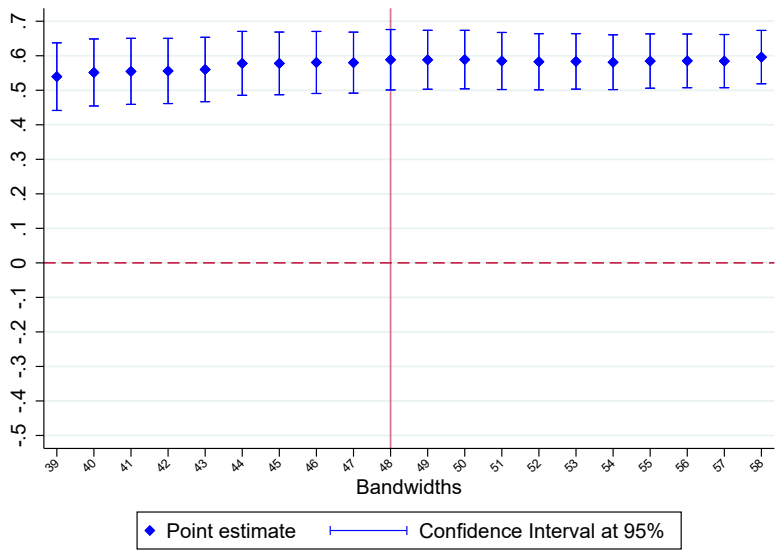
Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. Results obtained for individuals aged between 61 and 68 years old. We control for linear trends of age, continuous at the age of 11: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$.
Source: ESPS 2014.

Main Results – Robustness Checks

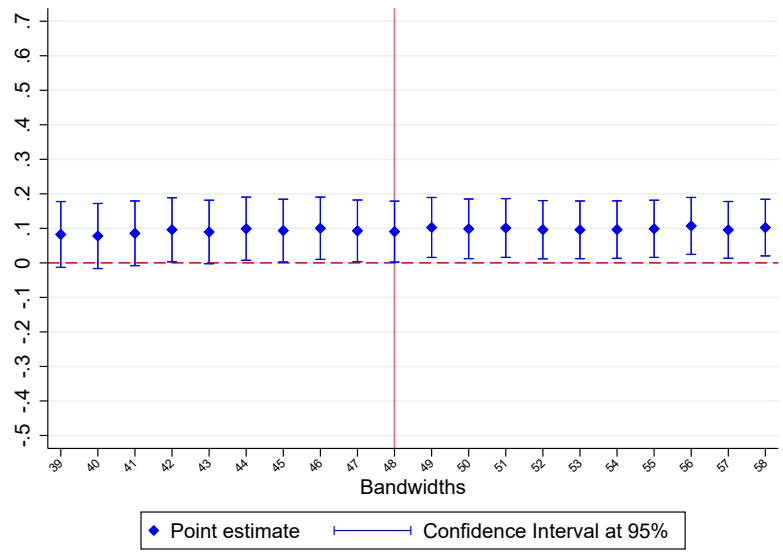
Our main results are confirmed when:

- we use different bandwidths.

Figure 5: Point estimates at the threshold by bandwidths with age defined monthly (non-eligible before 65) - local linear specification



(a) Flu vaccination invitation



(b) Flu vaccination take-up

Main Results – Robustness Checks

Our main results are confirmed when:

- we use quadratic specifications.
- we add control variables to the regressions.
- we rerun our regressions on a truncated sample from October 2014.
- we use non-parametric specifications.

Results - Heterogeneous effects

- We investigate whether the average effect on vaccination adherence may dissimulate heterogeneous effects.
- The reaction to the vaccination incentives may depend on the individual characteristics like gender, marital status, education or income.
- Interactions between $\mathbb{1}_{A_i \geq 65}$ and marital status, gender, diploma level and income $\rightarrow$ non-significant differences
- We also expect that the reaction to the campaign may depend on the individuals risk aversion and their health behaviour.
- Interaction between $\mathbb{1}_{A_i \geq 65}$ and health behaviour and risk aversion level.

Results by Health Risk Behaviour

Heterogeneous effects on flu vaccination invitation reception and flu vaccination take-up by health risk behaviour on non-eligible individuals (bw=48 months)

	Whole Sample		**Non-eligible before 65**	
	Vacc. Invite	Vacc. up-take	Vacc. Invite	Vacc. up-take
	(1)	(2)	(3)	(4)
$\mathbb{1}_{A_i \geq 65} \times$ Health Risk Behavior	-0.15***	-0.13***	-0.12***	-0.06
se	(0.04)	(0.05)	(0.04)	(0.06)
$\mathbb{1}_{A_i \geq 65}$	0.57***	0.17***	0.67***	0.15**
se	(0.04)	(0.04)	(0.05)	(0.06)
Health Risk Behavior	0.10***	0.04	0.07	-0.03
se	(0.04)	(0.03)	(0.03)	(0.03)
R^2	0.43	0.04	0.55	0.05
N	2,046	1,981	1,210	1,177

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. Results obtained for individuals aged between 61 and 68 years old. We control for linear trends of age, continuous at the age of 11: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$.
Source: ESPS 2014.

Results by Risk Aversion

Heterogeneous effects on flu vaccination invitation receipt and flu vaccination take-up by risk aversion characteristics on non-eligible individuals (bw=48 months)

	Whole Sample		**Non-eligible before 65**	
	Vacc. Invite	Vacc. up-take	Vacc. Invite	Vacc. up-take
	(1)	(2)	(3)	(4)
$\mathbb{1}_{A_i \geq 65} \times$RT	-0.08*	-0.10**	-0.08*	-0.09*
se	(0.04)	(0.05)	(0.05)	(0.05)
$\mathbb{1}_{A_i \geq 65}$	0.49***	0.09**	0.60***	0.13***
se	(0.04)	(0.04)	(0.05)	(0.05)
Risk Taker	0.07*	0.008	0.06	-0.002
se	(0.04)	(0.03)	(0.04)	(0.03)
R^2	0.43	0.04	0.55	0.05
N	1,983	1,919	1,189	1,155

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. Results obtained for individuals aged between 61 and 68 years old. We control for linear trends of age, continuous at the age of 65: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$.
Source: ESPS 2014.

Vaccination take-up by age and risk aversion level

Discussion

- Difference between the jump in probability of receiving the invitation (60pp) and the jump in probability of being vaccinated (10pp):
  - They don't get vaccinated every year
  - They do not consider flu to be a dangerous disease
  - The decrease in monetary cost is not compensatory for the non-monetary time.
- Heterogeneous effects
  - The effect on the vaccination adherence may be driven by individuals with healthy behaviour
  - Individuals with health risk behaviour do not respond to the incentive
    - Same reasons as previously
    - They don't read the mail $\rightarrow$ they ignored the invitation letter and are therefore unaware of their eligibility for free vaccination
    - Risk aversion

Discussion

- The difference in reaction is statistically significant for the risk takers.
  - The effect on the vaccination adherence is driven by the risk averse individuals (+13 pp)
  - The risk takers may not read the letter and are therefore not aware of their eligibility for free vaccination $\rightarrow$ the probability to report receiving the invitation is significantly lower for the risk takers, i.e. 60 pp versus 50 pp for individuals with healthy behaviour.
- The reaction of individuals may depend on the nature of their risk aversion, as there is a trade-off between the risk of side effects from the vaccine and the risk of catching the flu.
- However, the risk-averse individuals are more likely to be vaccinated at the age threshold meaning that the risk of the flu prevails for them.

Conclusion

- Individuals at 65 are aware that they are eligible for the free flu vaccination
- Positive but small effect on the probability to be vaccinated (10 pp)
- The average effect on vaccination adherence is dissimulated by heterogeneous:
  - The effect on the vaccination adherence is driven by individuals with healthy behaviour and the risk takers,
  - while the vaccination program has no effect for those with health risk behaviour and risk averse individuals.

Conclusion

- **People with health risk behaviour and risk takers do not react while they are more likely to develop severe forms of the disease.**
- This is a public policy issue as the decision-makers aim at identifying those who do not react to vaccination programs.
- The non-adhesion is harmful for individuals themselves, as well as for the whole population, while increasing vaccination adherence enables the virus propagation decrease.
- **A vaccination program targeting individuals with health risk behaviour would increase both the individual and the collective welfare.**

THANK YOU!

Appendix

The French Influenza Vaccination Program

Figure A1: Leaflet

Table A1: Comparison of treated and untreated groups, using a bandwidth of 5 years around the 65 years old threshold

	(1) Whole Sample	(2) Non Treated	(3) Treated	(4) T-test
Socio-demographic characteristics				
Head of household:				
Relationship	0.82	0.82	0.83	0.01
Male	0.48	0.47	0.50	0.03
Farmer	0.03	0.02	0.04	0.02**
Craftsman	0.11	0.12	0.10	-0.02
Executive	0.22	0.21	0.23	0.01
Intermediate occupation	0.21	0.20	0.22	0.03
Employee	0.13	0.14	0.12	-0.02
Blue Collar Worker	0.29	0.30	0.29	-0.02
Non active	0.01	0.01	0.00	-0.00
Pensioner	0.82	0.72	0.93	0.22***
High School diploma and more	0.22	0.24	0.20	-0.05**
Chronic diseases	0.34	0.29	0.39	0.10***
Household:				
Nb. of people	2.07	2.10	2.03	-0.07*
Equivalised income¿1 733.33 €	0.50	0.50	0.50	0.00
Health Investments:				
Risky alcohol consumption	0.23	0.25	0.21	-0.04*
Smoker	0.14	0.16	0.12	-0.04**
Healthy Diet	0.68	0.68	0.68	-0.00
Risk Aversion:				
Risk lover	0.22	0.22	0.21	-0.00
Outcomes				
Flu invitation reception	0.57	0.25	0.92	0.67***
Flu vaccination jab	0.30	0.21	0.40	0.19***
N	2,531	1,330	1,201	2,531

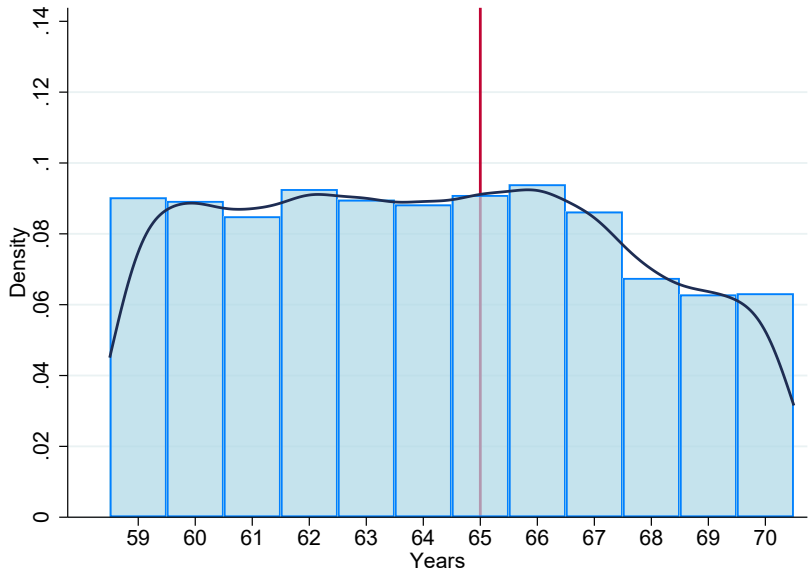
Note: ***Statistically significant at the 1% level; ** at the 5% level; * at the 10% level. Source: ESPS 2014.

Table A2: Placebo tests: RD estimates flu vaccination take-up (Bandwidth=48 months)

	Linear Spe.	**Quadratic Spe.**
	(1)	(2)
$\mathbb{1}_{A_i \geq 60}$	0.02	0.03
se	(0.04)	(0.05)
N	1,866	1,866
$\mathbb{1}_{A_i \geq 61}$	0.00	-0.02
se	(0.04)	(0.05)
N	1,871	1,871
$\mathbb{1}_{A_i \geq 62}$	-0.03	0.04
se	(0.04)	(0.05)
N	1,856	1,856
$\mathbb{1}_{A_i \geq 63}$	-0.00	0.03
se	(0.04)	(0.06)
N	1,898	1898
$\mathbb{1}_{A_i \geq 64}$	-0.01	-0.06
se	(0.04)	(0.06)
N	1,905	1,905

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. For local linear estimates, we control for linear trends of age, continuous at the age of 11: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$. For local quadratic estimates, we control for $(A_i - 65)\mathbb{1}_{A_i \geq 65}$, $(A_i - 65)\mathbb{1}^2_{A_i \geq 65} and (A_i - 65)\mathbb{1}_{A_i < 65}$,$(A_i - 65)\mathbb{1}^2_{A_i < 65}$; Source: ESPS 2014.

Figure A2: Density of the number of individuals per age



Note: Calculated by authors on ESPS 2014.

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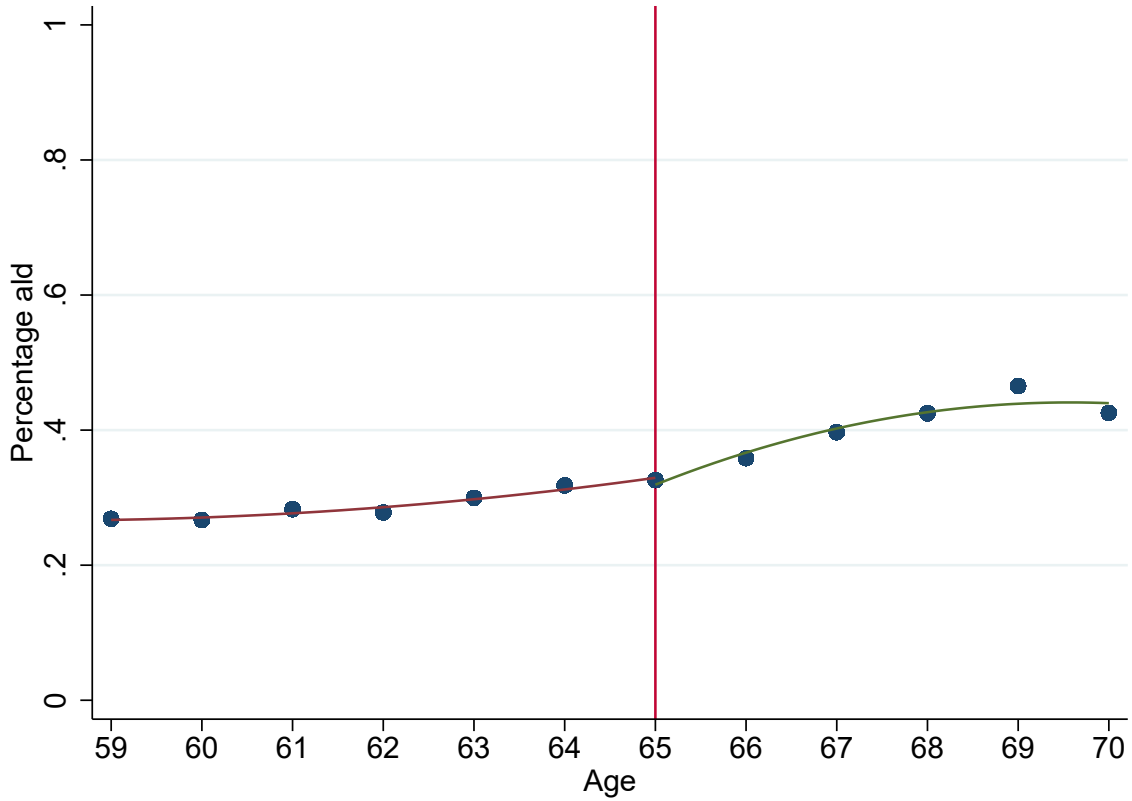

Figure A3: Percentage of people with a chronic illness by age

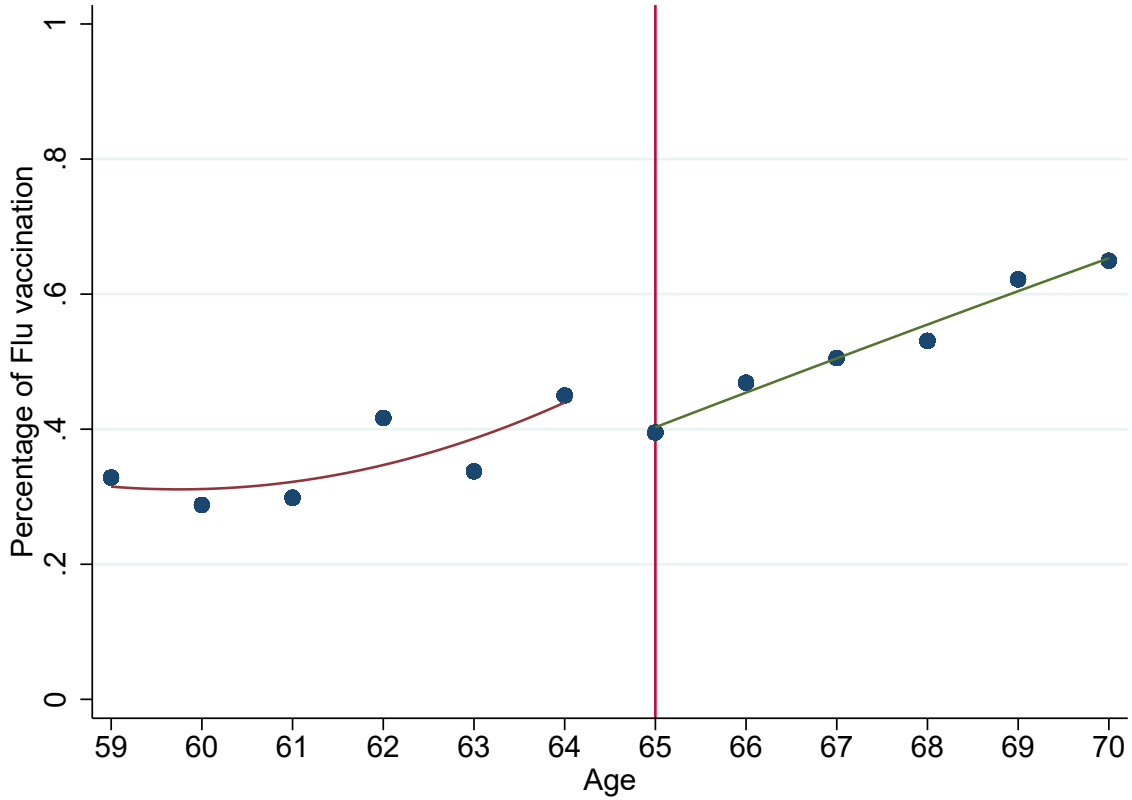

Figure A4: Flu vaccination rate among people with chronic illness

Regressions for people eligible before 65, coeff=-0.02 (se: 0.08)

Placebo test

Table A3: RDD estimates of vaccination invitation reception and vaccination up-take for people who are eligible before the threshold (age in month)

	Whole Sample		**Eligible before 65**	
	Vacc. Invite	Vacc. up-take	Vacc. Invite	Vacc. up-take
	(1)	(2)	(3)	(4)
$\mathbb{1}_{A_i \geq 65}$	0.46***	0.07*	0.25***	-0.02
se	(0.04)	(0.04)	(0.06)	(0.08)
R^2	0.43	0.03	0.24	0.02
N	2,046	1,981	713	685

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. Results obtained for individuals aged between 61 and 68 years old. We control for linear trends of age, continuous at the age of 11: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$.
Source: ESPS 2014.

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Table A4: Continuity in the characteristics: Local linear RDD estimates of socio-professional category (Bandwidth=48)

	Farmer	Craftsman	Executive	Intermediate Occupation	Employee	Blue Collar	Non Active
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Linear specification						
$\mathbb{1}_{A_i \geq 65}$	0.01	-0.02	0.02	0.01	-0.02	0.00	0.00
se	(0.02)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.01)
R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	2,057	2,057	2,057	2,057	2,057	2,057	2,057

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. For local linear estimates, we control for linear trends of age, continuous at the age of 65: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$; Source: ESPS 2014.

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Table A5: Continuity in the characteristics: Local Linear RDD estimates of socio-demographic characteristics (Bandwidth=48)

	Relationship	Male	High school Diploma	Chronic Disease	Eligible
	(1)	(2)	(3)	(4)	(5)
	Linear specification				
$\mathbb{1}_{A_i \geq 65}$	-0.00	0.02	0.02	-0.01	-0.01
se	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
R^2	0.00	0.00	0.01	0.01	0.01
N	2,068	2,068	2,068	2,057	1,941

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. For local linear estimates, we control for linear trends of age, continuous at the age of 65: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$; Source: ESPS 2014.

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Table A6: Continuity in the characteristics: Local Linear RDD estimates (Bandwidth=48)

	Health Risk Behaviour	Risk Takers
	(1)	(2)
	Local Linear Spline	
$\mathbb{1}_{A_i \geq 65}$	-0.03	-0.01
se	(0.03)	(0.04)
R^2	0.00	0.00
N	2099	1999

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. For local linear estimates, we control for linear trends of age, continuous at the age of 65: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$; Source: ESPS 2014.

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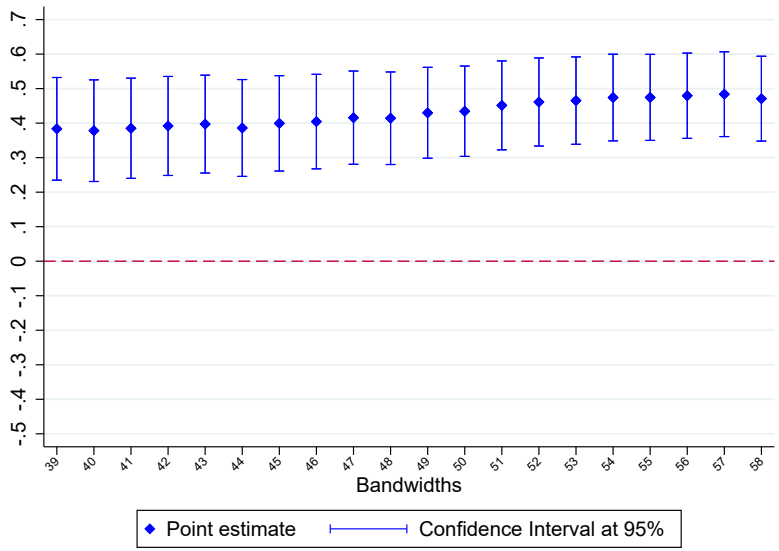
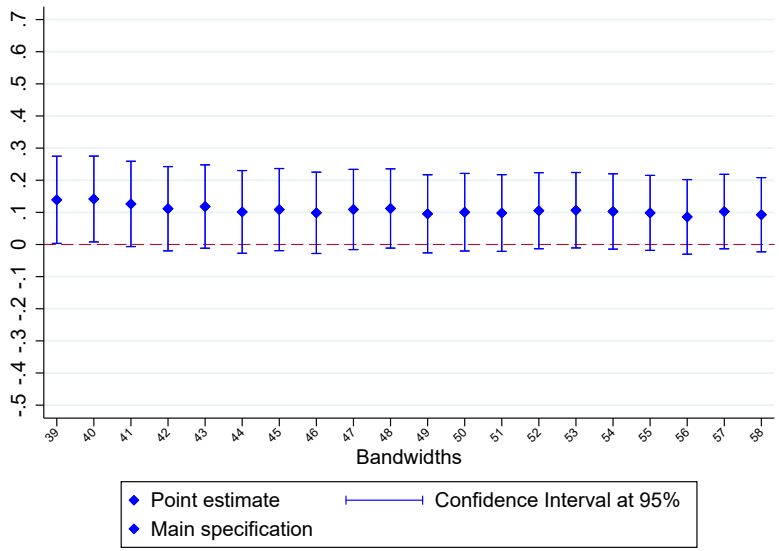
Figure A5: Point estimates at the threshold by bandwidths with age defined monthly (non-eligible before 65) - quadratic specification



(a) Flu vaccination invitation



(b) Flu vaccination take-up

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Main Results - age in month

RDD estimates of vaccination invitation reception and vaccination up-take (bw=48 months) – quadratic specification

	Whole Sample		**Non-eligible before 65**	
	Vacc. Invite	Vacc. up-take	Vacc. Invite	Vacc. up-take
	(1)	(2)	(3)	(4)
$\mathbb{1}_{A_i \geq 65}$	0.32***	0.05	0.42***	0.10
se	(0.06)	(0.06)	(0.07)	(0.06)
R^2	0.43	0.04	0.56	0.05
N	2,046	1,981	1,210	1,177

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. Results obtained for individuals aged between 61 and 68 years old. We control for linear trends of age, continuous at the age of 11: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$.
Source: ESPS 2014.

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Table A7: RDD estimates with additional controls: Local Linear specification

	Bandwidth=42		**Bandwidth=48**		**Bandwidth=54**	
	Invite	Up-take	Invite	Up-take	Invite	Up-take
	(1)	(2)	(3)	(4)	(5)	(6)
	Linear specification					
$\mathbb{1}_{A_i \geq 65}$	0.59***	0.12**	0.62***	0.12**	0.61***	0.13**
se	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)
R^2	0.57	0.06	0.57	0.06	0.60	0.06
N	788	770	883	862	980	955

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level.

Source: ESPS 2014.

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Table A8: RDD estimates with additional controls: Local quadratic specification

	Bandwidth=42		**Bandwidth=48**		**Bandwidth=54**	
	Invite	Up-take	Invite	Up-take	Invite	Up-take
	(1)	(2)	(3)	(4)	(5)	(6)
	Quadratic specification					
$\mathbb{1}_{A_i \geq 65}$	0.40***	0.14*	0.43***	0.13*	0.49***	0.13*
se	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)
R^2	0.58	0.06	0.58	0.06	0.60	0.06
N	788	770	883	862	980	955

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level.

Source: ESPS 2014.

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Table A9: Truncated sample from October 2014: RDD estimates of vaccination invitation reception and vaccination up-take (Bandwidth=48)

	Low-risk before the threshold	
	Vaccination Invite	Vaccination up-take
	(1)	(2)
	Local Linear	
$\mathbb{1}_{A_i \geq 65}$	0.75***	0.11**
se	(0.05)	(0.06)
R^2	0.64	0.06
N	730	711

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. For local linear estimates, we control for linear trends of age, continuous at the age of 11: $(A_i - 65)\mathbb{1}_{A_i \geq 65}$ and $(A_i - 65)\mathbb{1}_{A_i < 65}$.

Source: ESPS 2014.

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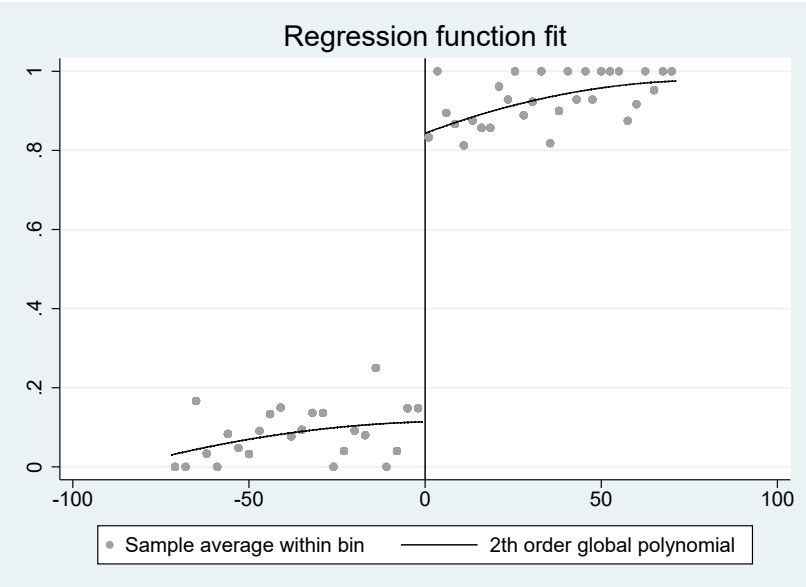
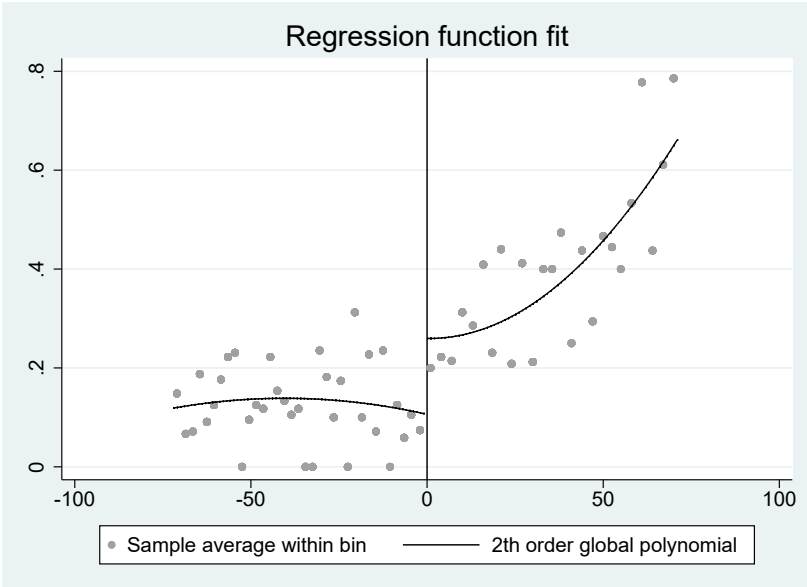
Figure A7: Flu vaccination invitation and flu vaccination take-up by bandwidths with age defined monthly (ind. non-eligible before 65)



(a) Flu vaccination invitation



(b) Flu vaccination take-up

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Non-parametric estimations

Table A10: Non-parametric estimations

	Vaccination Invitation			Vaccination Up-take		
	(1)	(2)	(3)	(4)	(5)	(6)
Coeff.	0.71***	0.70***	0.70***	0.13*	0.15**	0.15*
se	(0.07)	(0.07)	(0.08)	(0.07)	(0.07)	(0.09)
N	1,041	1,041	1,041	1,018	1,018	1,018

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level. Column (1) and (4) correspond to conventional RD estimates with a conventional variance estimator, column (2) and (5) to bias-corrected RD estimates with a conventional variance estimator and column (3) and (6) to bias-corrected RD estimates with a robust variance estimator. Kernel type=Triangular. The bandwidth selector is proposed by Calonico et al. (2014).
Source: ESPS 2014.

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Table A11: Heterogeneous effects by socio-demographic characteristics of non-eligible individuals (bw=48) - local linear specification

	Marital Status		Gender		Education		Income	
	Invite	Uptake	Invite	Uptake	Invite	Uptake	Invite	Uptake
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Linear specification							
$\mathbb{1}_{A_i \geq 65} \times$ Relationship	-0.06	0.06	-	-	-	-	-	-
se	(0.12)	(0.14)						
Relationship	0.01	-0.11	-	-	-	-	-	-
se	(0.09)	(0.09)						
$\mathbb{1}_{A_i \geq 65} \times$ Male	-	-	-0.18**	0.00	-	-	-	-
se			(0.09)	(0.09)				
Male	-	-	0.07	-0.03	-	-	-	-
se			(0.07)	(0.05)				
$\mathbb{1}_{A_i \geq 65} \times$ High sch.	-	-	-	-	-0.02	-0.08	-	-
se					(0.10)	(0.11)		
High School	-	-	-	-	0.05	0.06	-	-
se					(0.08)	(0.07)		
$\mathbb{1}_{A_i \geq 65} \times$ Inc.>Med.	-	-	-	-	-	-	-0.01	-0.04
se							(0.10)	(0.10)
Income>Median	-	-	-	-	-	-	0.05	0.01
se							(0.07)	(0.06)
$\mathbb{1}_{A_i \geq 65}$	0.64***	0.04	0.67***	0.09	0.59***	0.11**	0.62***	0.12
se	(0.11)	(0.13)	(0.05)	(0.06)	(0.05)	(0.05)	(0.07)	(0.08)
R^2	0.55	0.05	0.56	0.05	0.55	0.05	0.57	0.04
N	1,198	1,166	1,198	1,166	1,198	1,166	1,021	995

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level.
Source: ESPS 2014.

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Table A12: Heterogeneous effects by socio-demographic characteristics of non-eligible individuals (bw=48) - local quadratic specification

	Marital Status		Gender		Education		Income	
	Invite	Uptake	Invite	Uptake	Invite	Uptake	Invite	Uptake
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Quadratic specification							
$\mathbb{1}_{A_i \geq 65} \times$ Relationship	0.00	0.13	-	-	-	-	-	-
se	(0.20)	(0.22)						
Relationship	-0.00	-0.17	-	-	-	-	-	-
se	(0.16)	(0.14)						
$\mathbb{1}_{A_i \geq 65} \times$ Male	-	-	-0.31**	0.01	-	-	-	-
se			(0.14)	(0.13)				
Male	-	-	0.14	-0.04	-	-	-	-
se			(0.11)	(0.08)				
$\mathbb{1}_{A_i \geq 65} \times$ High sch.	-	-	-	-	-0.01	0.03	-	-
se					(0.15)	(0.14)		
High School	-	-	-	-	0.06	-0.03	-	-
se					(0.12)	(0.09)		
$\mathbb{1}_{A_i \geq 65} \times$ Inc.>Med.	-	-	-	-	-	-	-0.07	0.02
se							(0.15)	(0.15)
Income> Median	-	-	-	-	-	-	0.05	-0.03
se							(0.11)	(0.09)
$\mathbb{1}_{A_i \geq 65}$	0.41**	0.00	0.56***	0.11	0.42***	0.10	0.47***	0.10
se	(0.18)	(0.21)	(0.08)	(0.09)	(0.08)	(0.07)	(0.10)	(0.11)
R^2	0.56	0.05	0.56	0.05	0.56	0.06	0.58	0.04
N	1,198	1,166	1,198	1,166	1,198	1,166	1,021	995

Note: Standard errors in parentheses. ***Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level.
Source: ESPS 2014.

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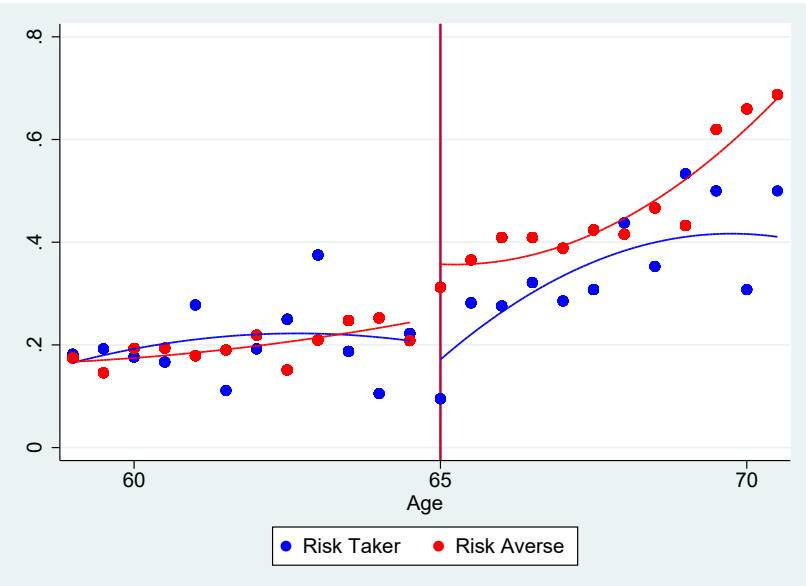
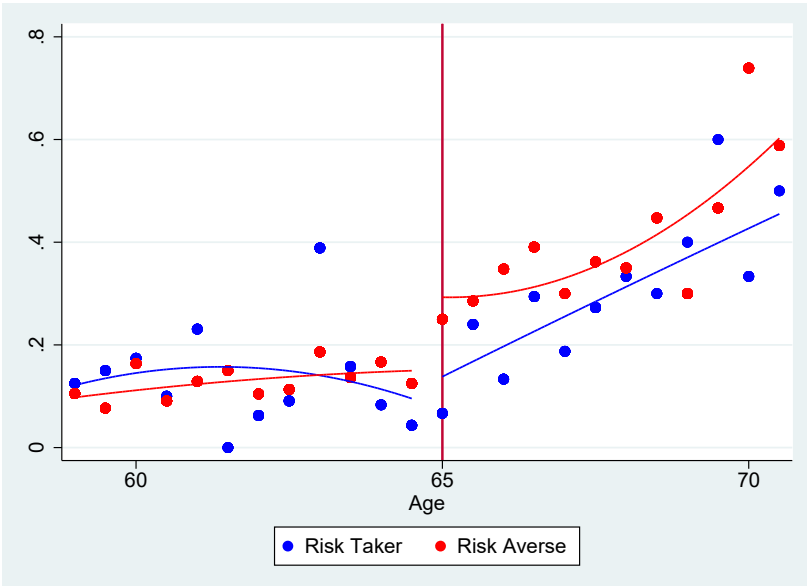
Figure A9: Vaccination take-up by age and risk aversion level



(a) Flu vaccination take-up (whole sample)



(b) Flu vaccination take-up (non eligible before 65)

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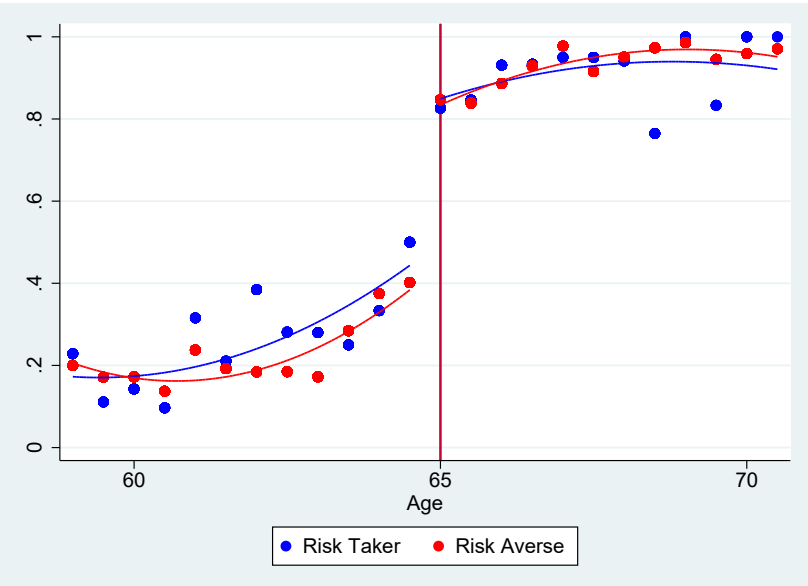
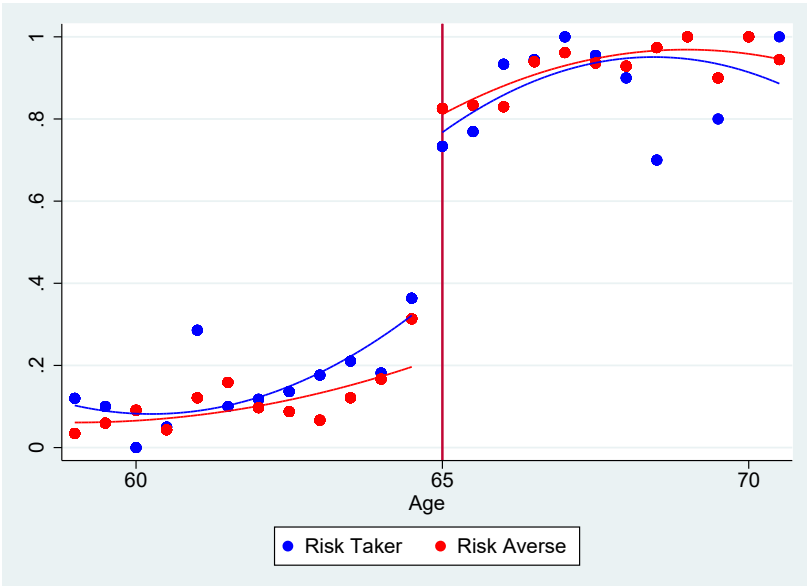
Figure A11: Vaccination invitation by age and risk aversion level



(a) Flu vaccination invitation (whole sample)



(b) Flu vaccination invitation (non eligible before 65)

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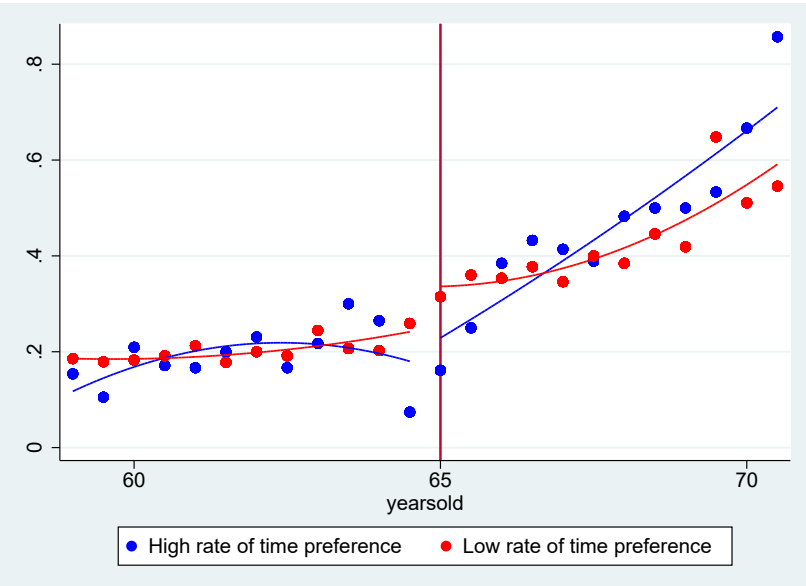
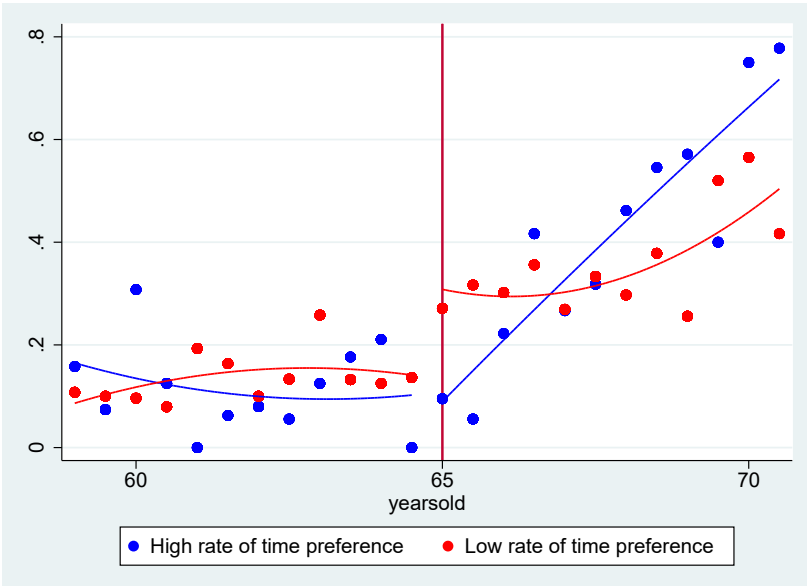
Figure A13: Vaccination take-up by age and time preference



(a) Flu vaccination take-up (whole sample)



(b) Flu vaccination take-up (non eligible before 65)

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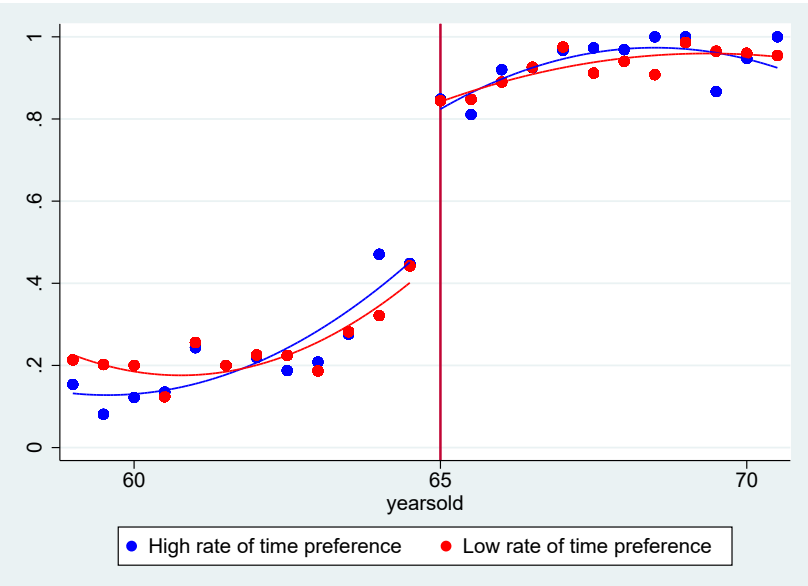
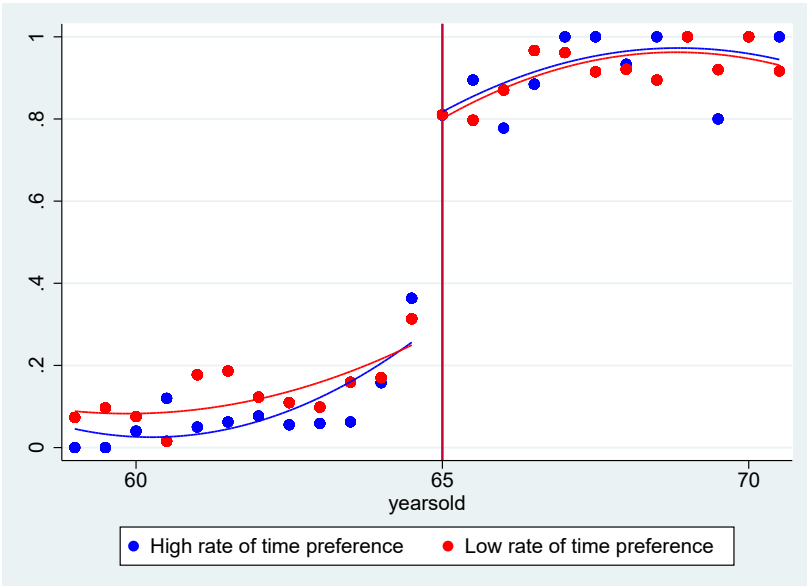
Figure A15: Vaccination invitation by age and time preference



(a) Flu vaccination invitation (whole sample)



(b) Flu vaccination invitation (non eligible before 65)

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