The Impact of an Epidemic: Experimental Evidence on Preference Stability from Wuhan

Jason Shachat, Durham University and Wuhan University

Matthew J. Walker, Durham University

Lijia Wei, Wuhan University

AEA Meeting 2021, Jan. 5th

Household Consequences of the Coronavirus and Its Aftermath: Microeconomic Outcomes

Introduction and Background

- We use financially incentivized decision-making experiments to assess the immediate and short-term impact of Covid-19 and associated events in China on pro-sociality, cooperation, trust and risk-related attitudes.

- Pre-crisis baseline: May 2019, 206 subjects complete a standard set of behavioral economics tasks collected

- Post-Crisis onset: A cross-section of 396 subject, collected in 5 waves, complete the same tasks.

- Subjects come from a population of 9,000 pre-registered Wuhan University student.

Introduction and Background

- **In December 2019**, a novel coronavirus and associated disease (Covid-19) was first reported in the city of Wuhan, the capital of China's Hubei province.

- **On January 20, 2020**, Person-to-person transmission of Covid-19 was publicly confirmed.

- **On January 23**, the central government of China imposed a strict lockdown in Wuhan, quickly followed by lockdown measures in the other 15 cities of Hubei province.

- The Hubei lockdown lasted in its most stringent form until **mid-March**.

- Unlike many previous studies, we go beyond a pre- and post-event comparison and identify preference perturbations within the formative period under study.

- **Wave1:** immediately after the announcement of the Wuhan city lockdown.

- **Wave 2 & Wave 3:** either side of Feb. 7 (the death of Dr. Li Wenliang).

- **Wave 4 & Wave 5:** at bi-weekly intervals after this event.

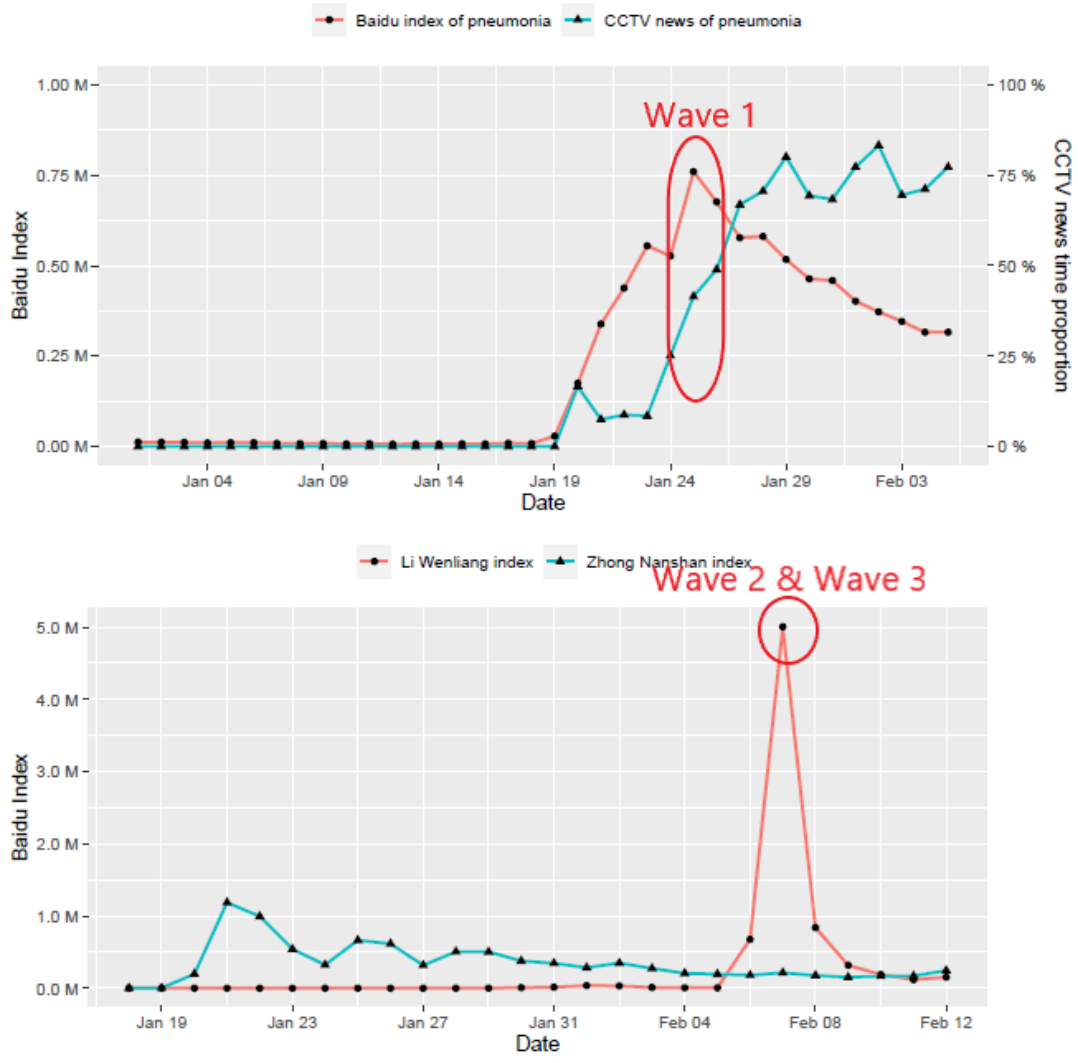
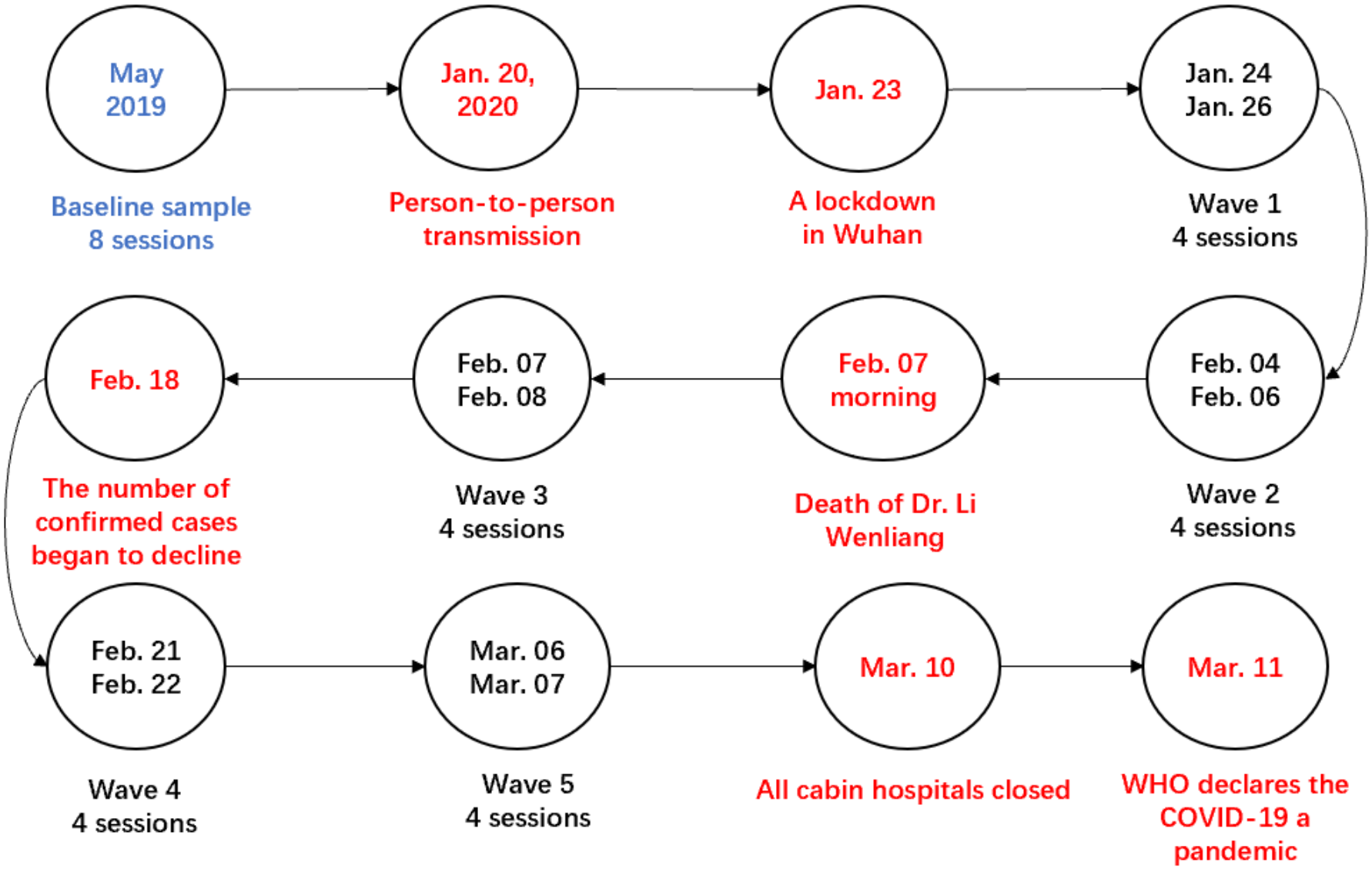


Figure 1: Public awareness of Covid-19 and related events in the early stages of the crisis

Notes. *Top panel*: The red series is the Baidu search index on the word pneumonia (in Chinese language). Max value is 760,460; The blue series is the time proportion spent covering pneumonia-related stories (later called Covid-19) on China Central Television (CCTV) news. Max value is 83%. *Bottom panel*: The red series is the Baidu search index on Li Wenliang. Max value is 5,007,063; The blue series is the Baidu search index on Zhong Nanshan, the chief scientist in China who first revealed human to human transmission of Covid-19. Max value is 1,186,091.

Experimental Design



Experimental Design

- **Five multi-persons decision problems**
  - **Dictator game (DG); Ultimatum game (UG); Trust game (TG); Prisoner's dilemma game (PD); Stag Hunt game.**

- **Individual decision-making tasks:**
  - **Risk attitude elicitation (gain domain); Risk attitude elicitation (loss domain); Ambiguity attitude elicitation:**

- **Questionnaire**

- **Payoff**: averaged 65.68 RMB (about 9.5 US dollars), including a participation fee of 10 RMB.

Risk attitude elicitation (gain domain)

Option A	Option B
○ 50-50 chance of receiving ￥9.00; 50-50 chance of receiving ￥3.00	○ ￥3.00 for sure
	○ ￥3.75 for sure
	○ ￥4.50 for sure
	○ ￥5.25 for sure
	○ ￥6.00 for sure
	○ ￥6.75 for sure
	○ ￥7.5 for sure
	○ ￥8.25 for sure
	○ ￥9.00 for sure

Submit

- Analogous method for loss domain and ambiguity elicitation.

Procedural details – Ancademy Experimental Platform

Invitations
- Using the cloud-based Ancademy.com platform and WHU subject pool.
- Ancademy.com is based on the open interface of WeChat.

Join
- Upon joining a session, subjects were redirected to a welcome screen describing the general experiment guidelines.

Experiment
- Tasks were completed sequentially, with instructions provided on arrival at each task
- Feedback was provided only after completion of all tasks.

Payment
- Subjects were paid based upon the outcomes of all tasks
- Via the WeChat pay facility on the same day

More details
- Using oTree
- Using mobile phone
- Subjects were able to contact the experimenter via WeChat

Pre- versus Post-lockdown analysis

Increase in pro-sociality (first-mover amounts) between baseline and post-lockdown samples

The propensity to cooperate in a PD increases by nearly one-third in the post-lockdown sample. No corresponding improvement in coordination in SH.

Table 2: Descriptive statistics pre-/post-lockdown.

Sample	2019 Baseline mean	sd.	2020 Post-lockdown mean	sd.	
Dictator game [0, 5]	1.45	1.08	1.65	1.08	*
Stag Hunt game {0,1}	0.88	0.33	0.77	0.42	***
Prisoner's Dilemma game {0,1}	0.31	0.46	0.41	0.49	**
Trust game sent [0, 8]	3.39	2.59	3.68	2.62	
Ultimatum game offer [0, 8]	3.08	1.04	3.30	1.21	*
Risk attitude, gain {1,2,...,10}	4.45	1.13	4.71	1.34	**
Risk attitude, loss {1,2,...,10}	6.42	1.14	6.27	1.18	**
Ambiguity attitude {1,2,...,10}	4.49	0.33	4.23	1.55	***
Observations	206		396		

*p <0.1, **p <0.05, ***p <0.01, based on two-tailed Wilcoxon rank-sum tests except for Stag Hunt and Prisoner's Dilemma games, which are based on two-tailed Fisher's Exact tests.

Pre- versus Post-lockdown analysis

No significant difference in amounts sent by first-movers in the Trust game

Significant differences in risk-related attitudes between the two samples

Heightened ambiguity aversion in the post-lockdown sample

Table 2: Descriptive statistics pre-/post-lockdown.

Sample	2019 Baseline mean	sd.	2020 Post-lockdown mean	sd.	
Dictator game [0, 5]	1.45	1.08	1.65	1.08	*
Stag Hunt game {0,1}	0.88	0.33	0.77	0.42	***
Prisoner's Dilemma game {0,1}	0.31	0.46	0.41	0.49	**
Trust game sent [0, 8]	3.39	2.59	3.68	2.62	
Ultimatum game offer [0, 8]	3.08	1.04	3.30	1.21	*
Risk attitude, gain {1,2,...,10}	4.45	1.13	4.71	1.34	**
Risk attitude, loss {1,2,...,10}	6.42	1.14	6.27	1.18	**
Ambiguity attitude {1,2,...,10}	4.49	0.33	4.23	1.55	***
Observations	206		396		

*p <0.1, **p <0.05, ***p <0.01, based on two-tailed Wilcoxon rank-sum tests except for Stag Hunt and Prisoner's Dilemma games, which are based on two-tailed Fisher's Exact tests.

Risk-related attitudes

The post-lockdown distribution of switching points in the gain domain lies weakly to the right of the baseline distribution;

The reverse is observed in the loss domain among all but the most risk-seeking subjects.

There is also a shift left in the distribution in the ambiguity elicitation task post-lockdown.

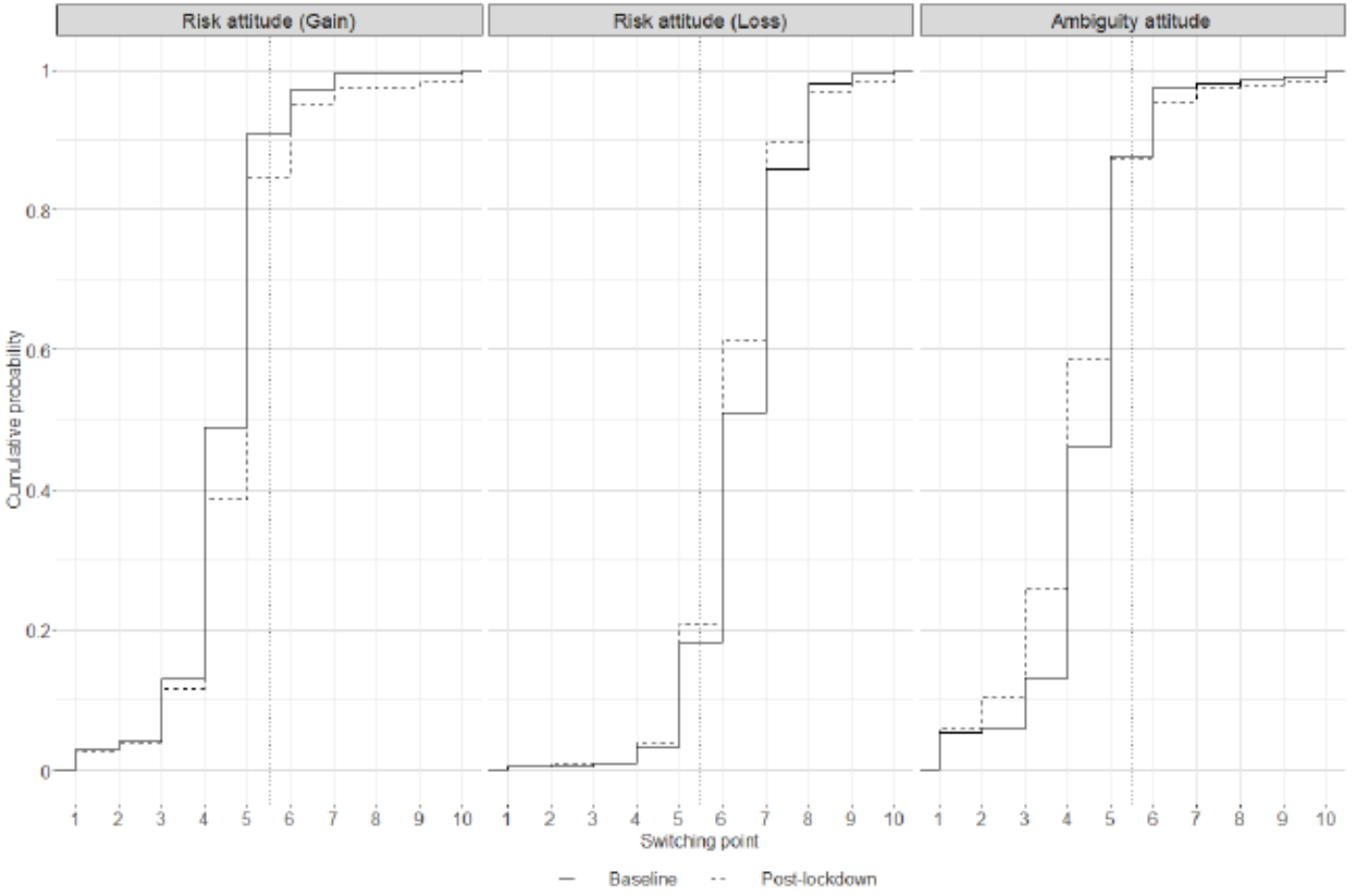


Figure 3: Comparison of c.d.f.s for switching points in the risk and ambiguity attitude elicitation tasks; the vertical dotted line corresponds to risk neutrality.

Pre – versus Post-lockdown analysis

The impact of the exogenous Covid-19 shock is captured by a dummy variable for the post-lockdown sample.

Higher altruism and trust in the post-lockdown

A significant fall in trust among those subjects located in Wuhan during the lockdown

UG: no longer significantly. This effect appears to be subsumed by a strong positive coefficient estimate on the indicator for being in Hubei (outside Wuhan) during the lockdown period.

Table 3: Regression analysis pre-/post-lockdown.

	Dependent variable							
	Trust	Pro-sociality		Cooperation		Risk		Ambiguity
		DG	UG	SH	PD	Gain	Loss	
	OLS	*OLS*	*OLS*	*Logistic*	*Logistic*	*OLS*	*OLS*	*OLS*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-lockdown	0.85*	0.27*	0.15	−0.70***	0.63***	0.26**	−0.24**	−0.32**
	(0.45)	(0.14)	(0.21)	(0.27)	(0.21)	(0.12)	(0.11)	(0.13)
Wuhan	−2.35***	−0.26	−0.03	−0.08	−0.76*	−0.16	−0.01	−0.20
	(0.68)	(0.24)	(0.50)	(0.42)	(0.41)	(0.21)	(0.17)	(0.25)
Other Hubei	1.28*	0.20	0.65***	−0.06	−0.33	−0.23	0.10	−0.01
	(0.68)	(0.19)	(0.24)	(0.31)	(0.26)	(0.16)	(0.16)	(0.20)
Female	1.11***	0.35***	.19	0.19	0.47***	−0.19*	−0.13	−0.10
	(0.40)	(0.12)	(0.19)	(0.22)	(0.18)	(0.11)	(0.09)	(0.12)
Econ	0.91*	−0.05	−0.39	−0.15	−0.17	−0.06	0.06	−0.08
	(0.54)	(0.15)	(0.28)	(0.28)	(0.23)	(0.12)	(0.12)	(0.14)
(Intercept)	3.15	4.09***	5.58**	1.79	−2.74	3.36*	3.28**	0.21
	(6.73)	(1.55)	(2.41)	(2.93)	(2.30)	(1.77)	(1.30)	(1.82)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	153	304	151	593	594	565	581	573
R^2	0.16	0.09	0.13			0.03	0.06	0.03
Log Likelihood				−280.50	−382.35			

Note: *p <0.1; **p <0.05; ***p <0.01.
Coefficient estimates with robust standard errors in parentheses.

Pre – versus Post-lockdown analysis

A strong positive effect of the post-lockdown dummy on cooperation in the PD and the negative effect on coordination in the SH game.

Significant reductions of risk aversion in gains and risk tolerance in losses.

Significant increasement in ambiguity aversion.

Female subjects are more risk averse, trusting, altruistic and cooperative than their male counterparts.

Table 3: Regression analysis pre-/post-lockdown.

	Dependent variable							
	Trust	Pro-sociality		Cooperation		Risk		Ambiguity
		DG	UG	SH	PD	Gain	Loss	
	OLS	*OLS*	*OLS*	*Logistic*	*Logistic*	*OLS*	*OLS*	*OLS*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-lockdown	0.85*	0.27*	0.15	−0.70***	0.63***	0.26**	−0.24**	−0.32**
	(0.45)	(0.14)	(0.21)	(0.27)	(0.21)	(0.12)	(0.11)	(0.13)
Wuhan	−2.35***	−0.26	−0.03	−0.08	−0.76*	−0.16	−0.01	−0.20
	(0.68)	(0.24)	(0.50)	(0.42)	(0.41)	(0.21)	(0.17)	(0.25)
Other Hubei	1.28*	0.20	0.65***	−0.06	−0.33	−0.23	0.10	−0.01
	(0.68)	(0.19)	(0.24)	(0.31)	(0.26)	(0.16)	(0.16)	(0.20)
Female	1.11***	0.35***	0.19	0.19	0.47***	−0.19*	−0.13	−0.10
	(0.40)	(0.12)	(0.19)	(0.22)	(0.18)	(0.11)	(0.09)	(0.12)
Econ	0.91*	−0.05	−0.39	−0.15	−0.17	−0.06	0.06	−0.08
	(0.54)	(0.15)	(0.28)	(0.28)	(0.23)	(0.12)	(0.12)	(0.14)
(Intercept)	3.15	4.09***	5.58**	1.79	−2.74	3.36*	3.28**	0.21
	(6.73)	(1.55)	(2.41)	(2.93)	(2.30)	(1.77)	(1.30)	(1.82)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	153	304	151	593	594	565	581	573
R^2	0.16	0.09	0.13			0.03	0.06	0.03
Log Likelihood				−280.50	−382.35			

Note: *p <0.1; **p <0.05; ***p <0.01.
Coefficient estimates with robust standard errors in parentheses.

Post-lockdown transitory effects

The reference wave to be Wave 3 -- midpoint during post-lockdown sampling and has the benefit of clearly revealing any short-term preference changes in the immediate aftermath of the death of Dr. Li Wenliang.

Wave 3 is strongly associated with lower trust and increased risk aversion in gains, versus Wave 2

Table 4: Regression analysis of the post-lockdown sampling waves only.

	Dependent variable:							
	Trust	DG	UG	SH	PD	Risk+	Risk-	Ambiguity
	OLS	*OLS*	*OLS*	*Logistic*	*Logistic*	*OLS*	*OLS*	*OLS*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wave 1	−1.85***	0.16	−0.11	0.71*	0.50	0.43**	0.22	−0.04
	(0.64)	(0.22)	(0.36)	(0.40)	(0.35)	(0.17)	(0.18)	(0.25)
Wave 2	1.47**	0.29	−0.18	0.67*	0.34	0.67***	0.18	−0.25
	(0.66)	(0.22)	(0.38)	(0.40)	(0.34)	(0.23)	(0.20)	(0.26)
Wave 4	0.28	0.17	−0.39	0.02	−0.34	0.44**	0.38**	0.25
	(0.81)	(0.23)	(0.33)	(0.36)	(0.34)	(0.21)	(0.18)	(0.27)
Wave 5	0.18	0.51**	−0.03	0.64	0.11	0.70***	0.20	0.31
	(0.71)	(0.22)	(0.29)	(0.40)	(0.33)	(0.23)	(0.20)	(0.27)
(Intercept)	−12.77*	2.84	3.32	−1.50	−4.59	0.62	2.18	−2.23
	(7.72)	(1.96)	(3.47)	(3.52)	(2.95)	(2.52)	(1.75)	(2.56)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	99	196	97	388	389	366	378	370
R^2	0.38	0.15	0.26			0.06	0.07	0.05
Log Likelihood				−199.71	−252.30			

Note: $^*p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.
Coefficient estimates with robust standard errors in parentheses.

Conclusion

1. The results suggest that social and risk-related preferences are liable to be influenced by formative events associated with a public health crisis.

2. Post-lockdown, subjects exhibit greater sensitivity to ambiguity and risk in both gain and loss domains.

3. There is also some evidence of an increase in cooperation and pro-sociality.

4. We go further and uncover significant transitory effects on trust and risk aversion within the post-lockdown period - in particular, around the death of a high-profile Chinese whistleblower.

Sample demographics

We control in our analysis for a range of observed demographic, location-based and interface variables.

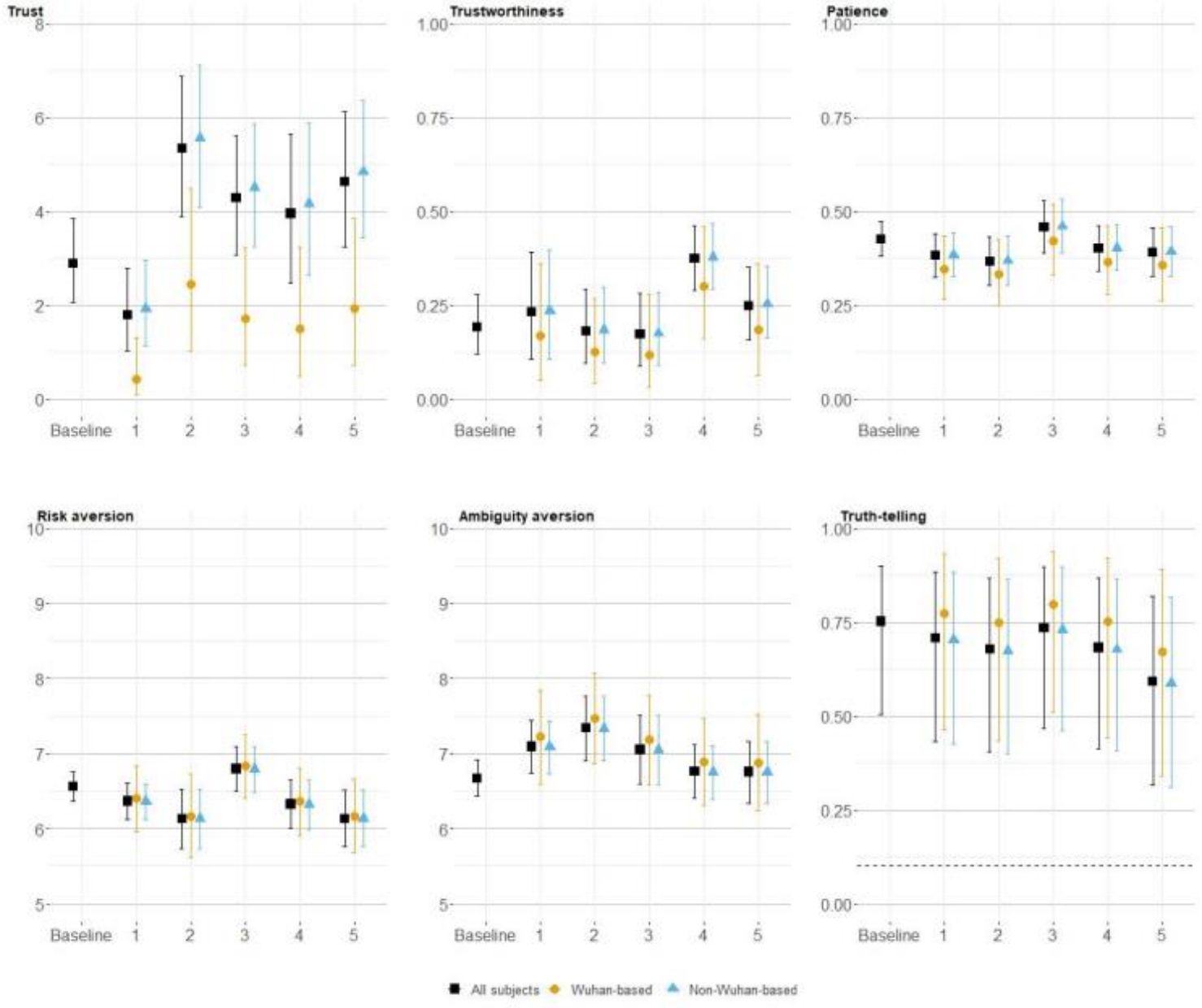
The only systematic differences we identify between samples are in the proportions of female subjects and economics majors, which are higher in the baseline sample.

Table 1: Sample characteristics (control variables).

	Full sample	Baseline	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5
Number of subjects	602	206	80	78	80	78	80
Age	20.41	20.17	20.11	20.58	20.70	21.05	20.23
	[1.84]	[1.67]	[1.51]	[1.90]	[1.78]	[2.68]	[1.27]
Female	0.59	0.69	0.56	0.45	0.56	0.56	0.55
	[0.49]	[0.46]	[0.50]	[0.50]	[0.50]	[0.50]	[0.50]
Econ major	0.22	0.32	0.20	0.19	0.20	0.12	0.11
	[0.41]	[0.47]	[0.40]	[0.40]	[0.40]	[0.32]	[0.32]
Monthly Expenditure	2.58	2.57	2.54	2.51	2.62	2.59	2.65
	[0.68]	[0.71]	[0.62]	[0.68]	[0.68]	[0.71]	[0.66]
Annual Income	2.60	2.62	2.50	2.68	2.66	2.55	2.59
	[0.94]	[0.93]	[0.87]	[1.05]	[1.01]	[0.91]	[0.90]
Wuhan	0.10		0.11	0.10	0.12	0.06	0.08
	[0.29]		[0.32]	[0.31]	[0.33]	[0.25]	[0.27]
Other Hubei	0.21		0.18	0.19	0.25	0.14	0.31
	[0.41]		[0.38]	[0.40]	[0.44]	[0.35]	[0.47]
Phone Size (in)	5.89	5.74	6.04	5.93	5.93	5.99	5.93
	[0.54]	[0.58]	[0.47]	[0.48]	[0.59]	[0.49]	[0.52]
iOS	0.21	0.25	0.19	0.13	0.25	0.10	0.26
	[0.41]	[0.44]	[0.39]	[0.34]	[0.44]	[0.31]	[0.44]

Note: Mean values with standard deviation in square brackets.
Monthly Expenditure (Annual Income): 1 = less than 800 (30,000) RMB ;
2 = 800 (30,000) ~ 1500 (100,000) RMB; 3 = 1500 (100,000) ~ 2500 (200,000) RMB;
4 = 2500 (200,000) ~ 4000 (400,000) RMB; 5 = greater than 4000 (400,000) RMB.

Fitted values of the main outcome variables by experiment waves



Baseline re-sampling and selective participation

Table 5: Descriptive statistics and hypothesis tests for the baseline re-sample.

	Baseline 2019 May		Re-sample 2020 Feb 15-16		2020 new subjects Wave 3		Wave 4		Wave 3 & 4	
	mean	sd.	mean	sd.	mean	sd.	mean	sd.	mean	sd.
Risk attitude, gain {1,2,...,10}	4.49	0.92	4.51	1.06	4.26	1.18	4.71	1.42	4.48	1.32
Risk attitude, loss {1,2,...,10}	6.31	0.97	6.49	1.02	6.12^{A}	1.31	6.50	1.00	6.30	1.19
Ambiguity attitude {1,2,...,10}	4.50	1.13	4.05^{D}	1.15	4.18	1.75	4.41	1.55	4.29	1.66
Number of subjects	92		92		80		78		158	

$^{a}p<0.1$, $^{A}p<0.05$, $^{\mathbf{A}}p<0.01$ for comparison of means unpaired sample Wave versus Re-sample;
$^{d}p<0.1$, $^{D}p<0.05$, $^{\mathbf{D}}p<0.01$ for comparison of means paired Re-sample versus Baseline.
For unpaired sample comparisons, two-tailed Wilcoxon rank-sum tests.
For paired sample comparisons, two-tailed Wilcoxon signed-rank tests.

Present results from a wave of 92 subject who participated in our original baseline study and then again in a wave conducted February 15-16

Baseline Vs. Re-sample: no significant in risk attitude and significant increase in average ambiguity aversion

Re-sample Vs. Wave 3 & Wave 4: only significant difference is for risk attitude for losses in Wave 3

Another study: Viral social media videos can raise pro-social behaviours when an epidemic arises

- **Two treatment groups**
- **Leadership video:** shows a senior central government official's visit to a local hospital and a supermarket on Jan. 27, 2020.
- **Volunteer video:** shows health care volunteers in transit to Wuhan.

- **Control group**
- **Neutral video:** neutral product advertisement, unrelated to the crisis.

- Videos approx. two minutes in length; watched twice before experiments.
- Run between Waves 1 and 2, the worst time of epidemic in Wuhan.

Contribution in context

- Our study contributes to an established economics literature on the stability of economic preferences (e.g., Malmendier and Nagel 2011).

- We also add to a rapidly growing literature assessing the impact of the Covid-19 pandemic on economic preferences and beliefs in China (e.g., Li 2020, Bu et al. 2020, Lohmann et al. 2020)