P(l)ay-As-You-Go:

Large-Scale Longitudinal Risk-Elicitation in the Field

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Motivation

- How to repeatedly measure individual risk attitudes at a large scale?
  - **Survey-based approaches:** fast, relatively inexpensive but generally not incentive compatible.
  - **Experimental methods:** more precise, incentive compatible, but they are rarely used in field studies (time, cost, complexity, infrastructure needs). (Charness, Gneezy and Imas, 2013)

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☞ **One solution:** Use digital technologies in B2C communication.
Best of both worlds?

What we do

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- Objective: construction of a panel + relate risk attitudes to choices and behavior.
- Contribute to literature on stability of (risk) preferences

  (Schildberg-Hörisch, 2018; Meier, 2022; Bokern et al., 2023)
- Invite visitors to . . .
  - . . . play the incentivized **Bomb Risk Elicitation Task (BRET)** (Crosetto and Fillipin, 2013)
    - Participants play for TICKETS in monthly prize draw
    - Robustness check: Subsample plays for DISCOUNT
  - . . . answer the non-incentivized **SOEP risk question** (Dohmen et al., 2011)

P(l)ay-As-You-Go: BRET and SOEP

Instructions BRET

The game has 100 boxes. 99 boxes contain a ticket but one random box contains a bomb.

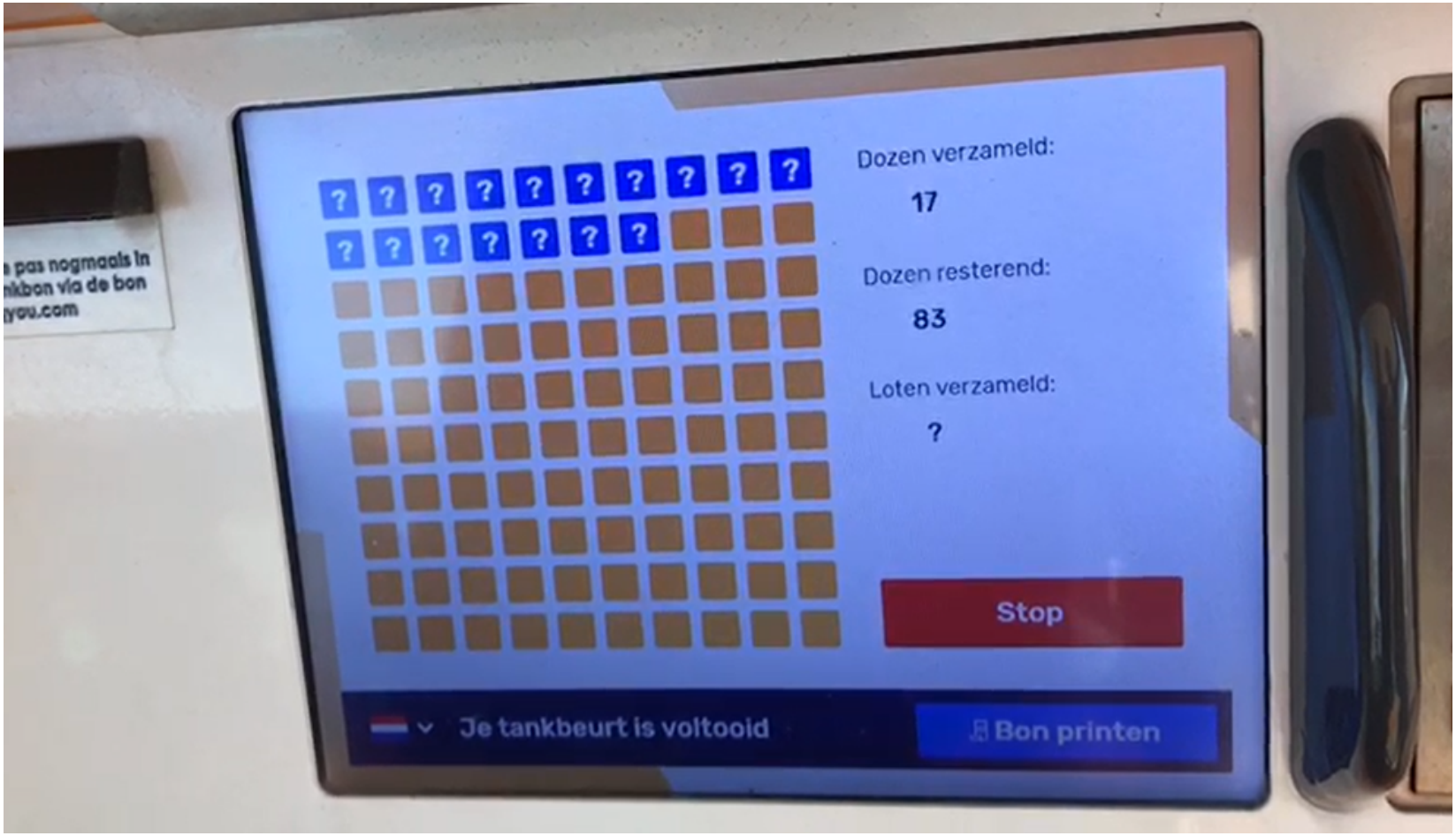
When the game starts you collect a box every 0.4 seconds until you press the stop button.

Earn tickets by collecting boxes, but if you collect the bomb, you will lose all the tickets you have collected with this game (you keep the tickets you have earned with refueling).

The SOEP general risk question

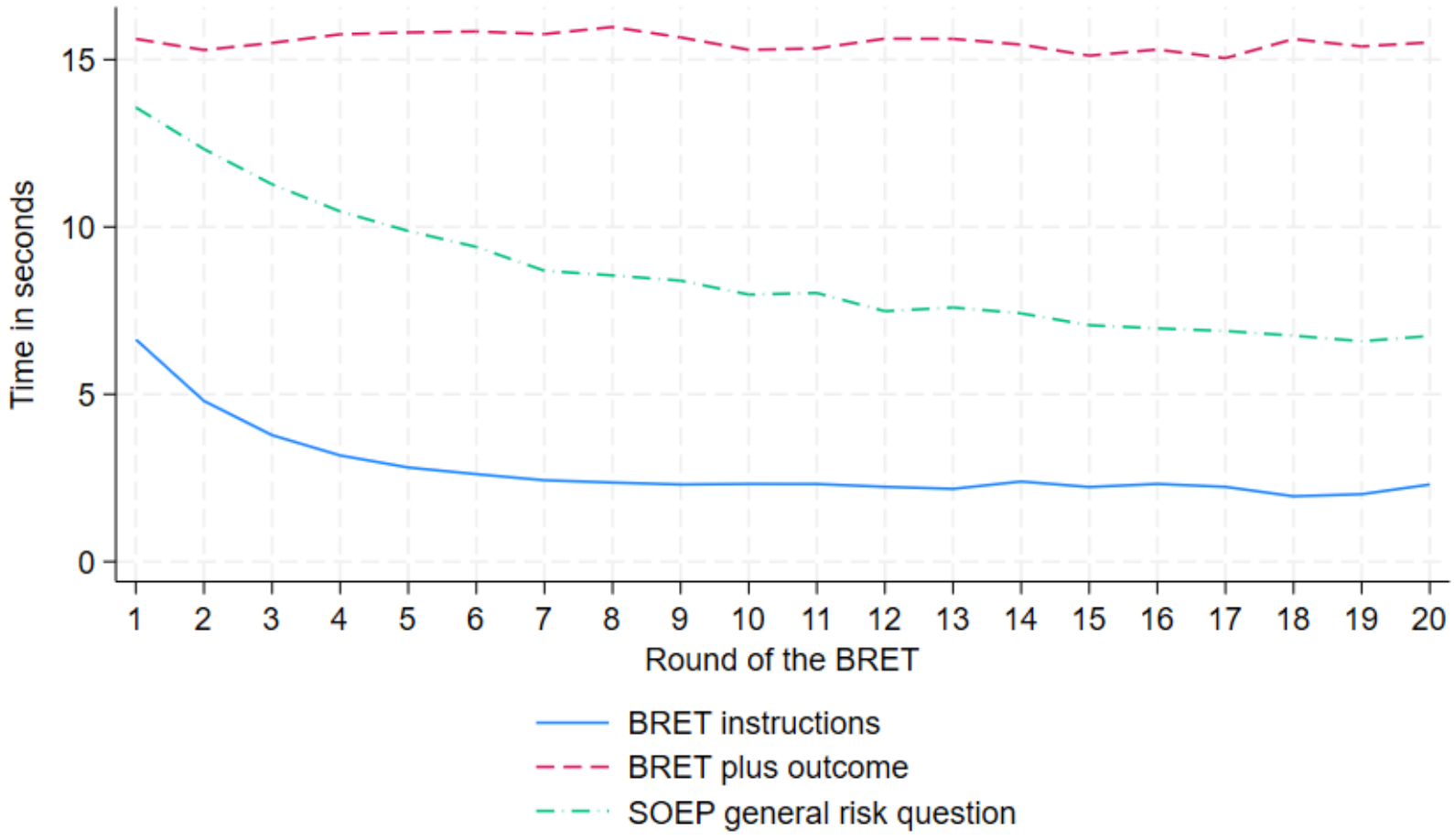
One last question: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?
0 = Not at all willing to take risks
10 = Very willing to take risks

P(l)ay-As-You-Go: Implementation



P(l)ay-As-You-Go: Implementation

P(l)ay-As-You-Go: Time Spent on Tasks per Round



▸ Example

Summary statistics participants

- Data collection period: 27 June 2019 – 21 December 2023
- 22 locations in the Netherlands ▸ details

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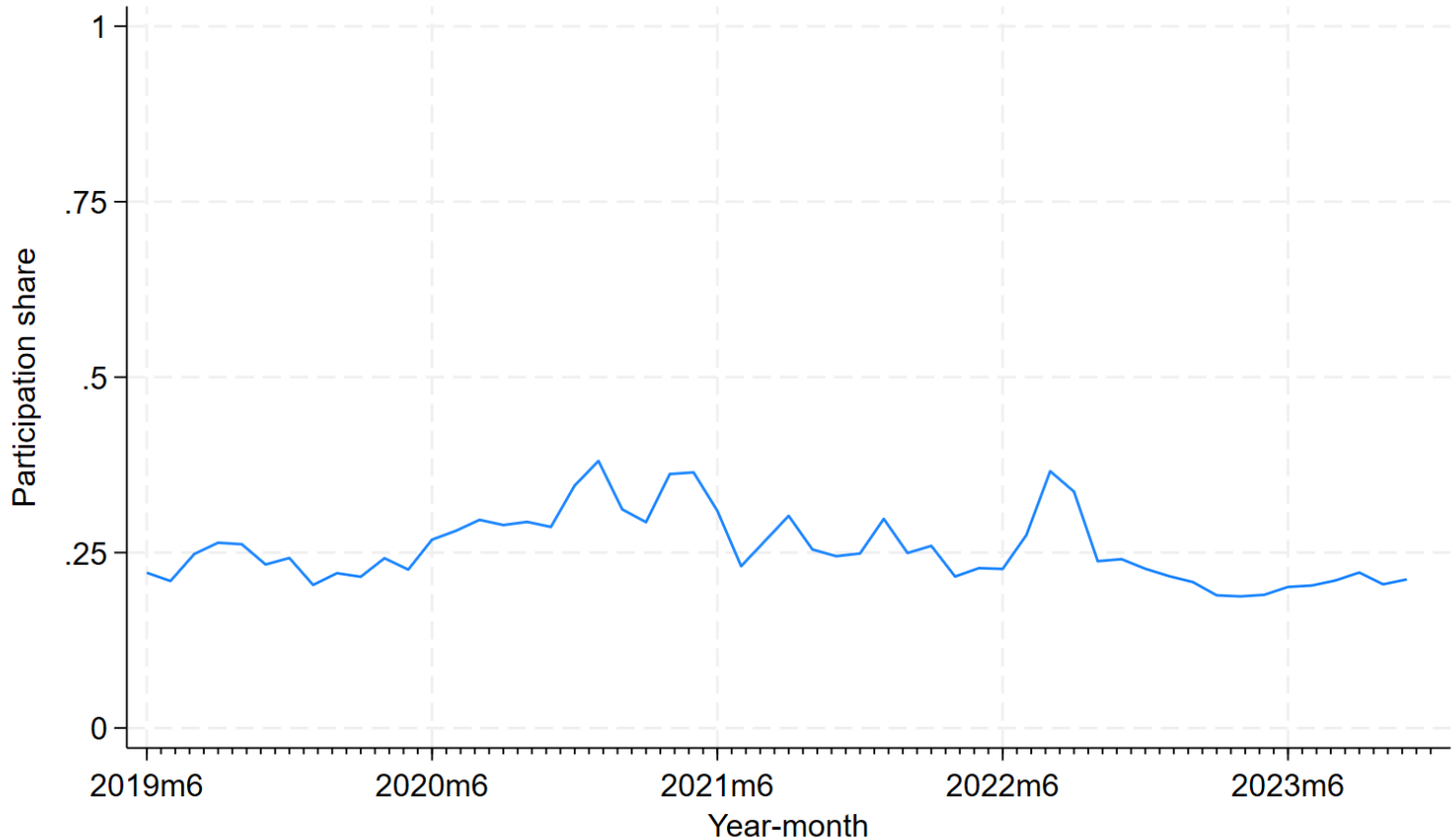
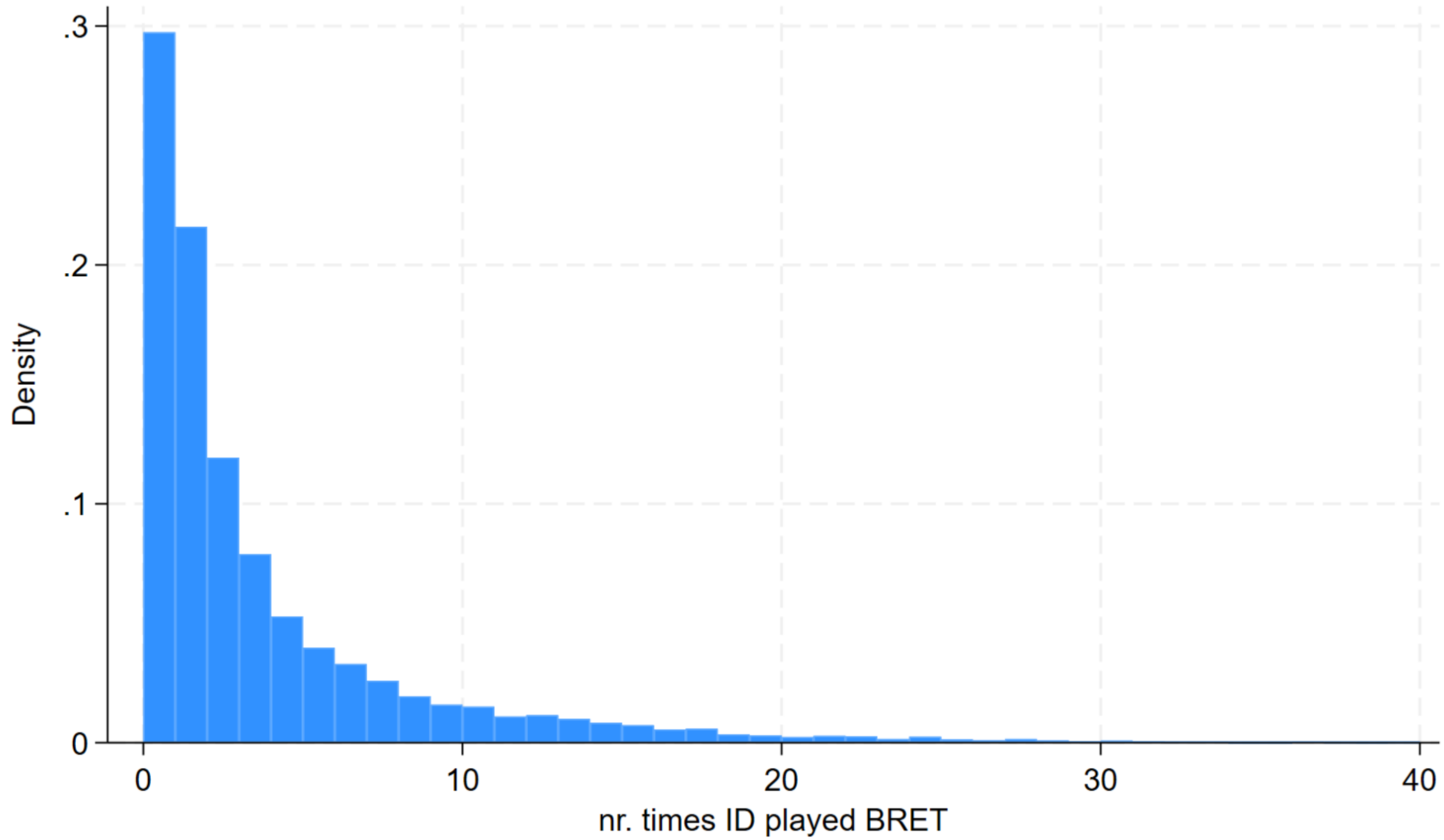
	mean	S.D.	min	max
Driver and vehicle characteristics				
Age	45	13.61	18	84
Female	0.31			
Cat. vehicle price when new (in 1,000€)	30.48	19.39	7.50	354.70
Tank volume (litres)	52	12.53	6	100
BRET and SOEP				
Fraction of time subject completed BRET	0.46	0.31	0.01	1
Nr. of times a subject played BRET	4.99	5.41	1	40
Number of boxes collected in the BRET	34.23	18.29	1	99
Fraction of time subject completed SOEP	0.37	0.31	0	1
Nr. of times a subject answered SOEP	4.13	4.93	0	37
SOEP score by subject	6.58	1.79	1	10
Number of subjects	7,236			
Nr. of times BRET completed	34,490			
- *For prize draw tickets*	32,294			
- *For parking discounts*	2,196			
Nr. of times SOEP completed	28,731			

Response rate over time

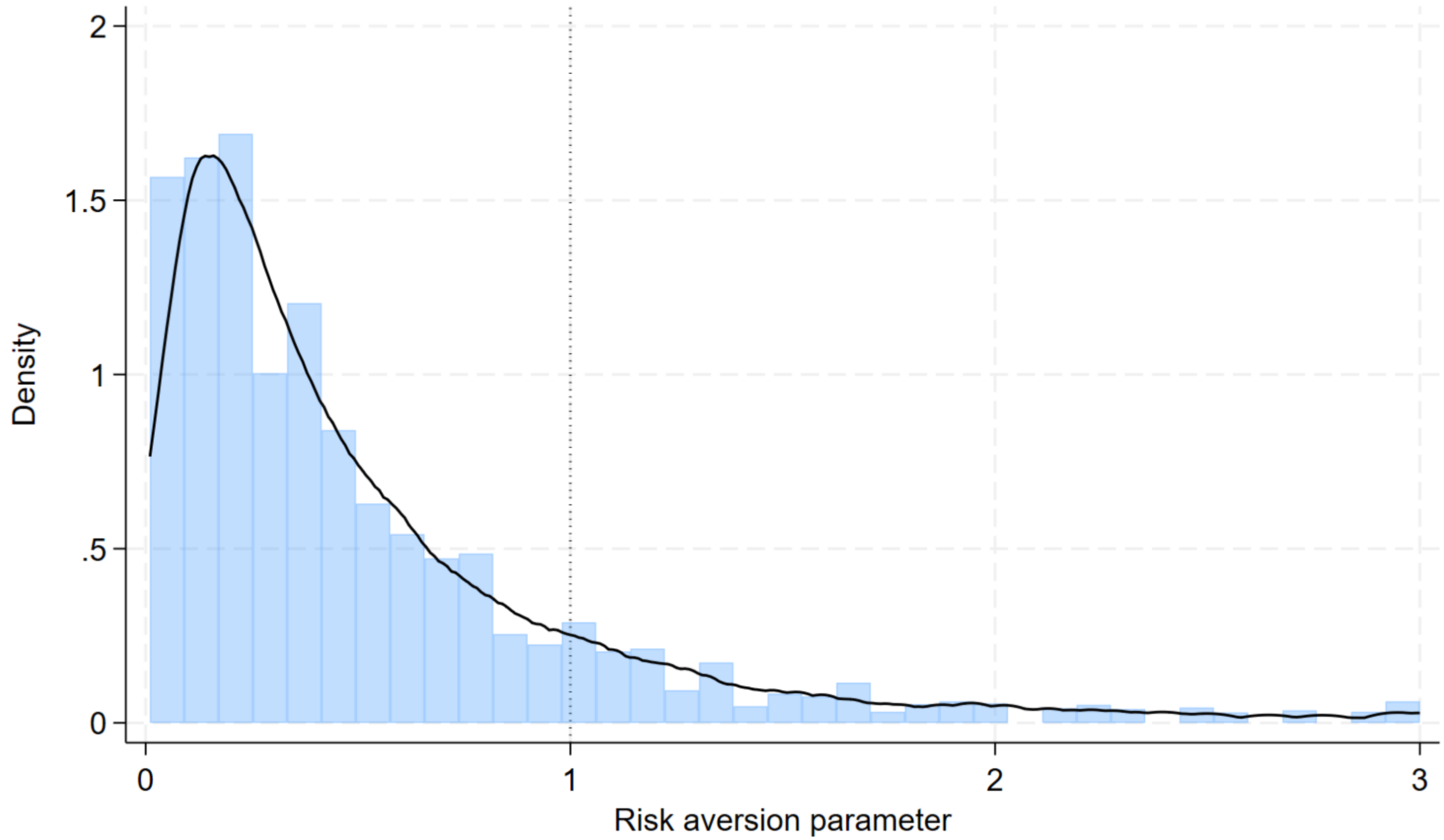


Repeated play



Results

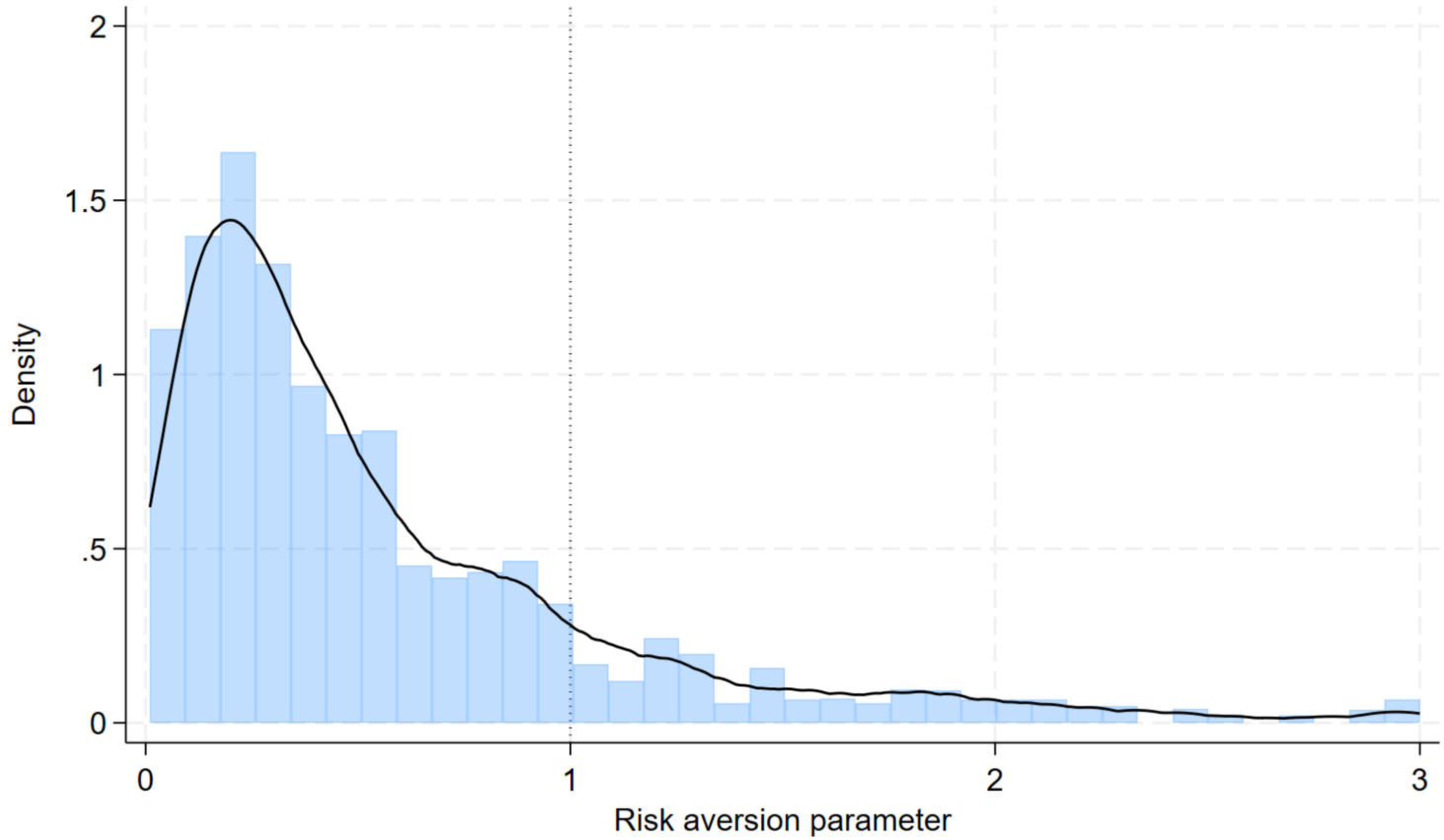
Distribution of the Risk Aversion Parameter r



1st BRET-Tickets

Notes: Based on the CRRA utility function $u(k) = k^r$, where k is the number of boxes collected in the Bomb Risk Elicitation Task (BRET). For ease of illustration, the range of parameter values shown is restricted to $r \leq 3$. The red dotted line indicates the risk aversion parameter of risk neutrality ($r = 1$). Parameter values smaller (greater) than $r = 1$ indicate risk aversion (risk loving). The figure is based on first-round choices in the BRET.

Distribution of the Risk Aversion Parameter r



2nd BRET-Tickets

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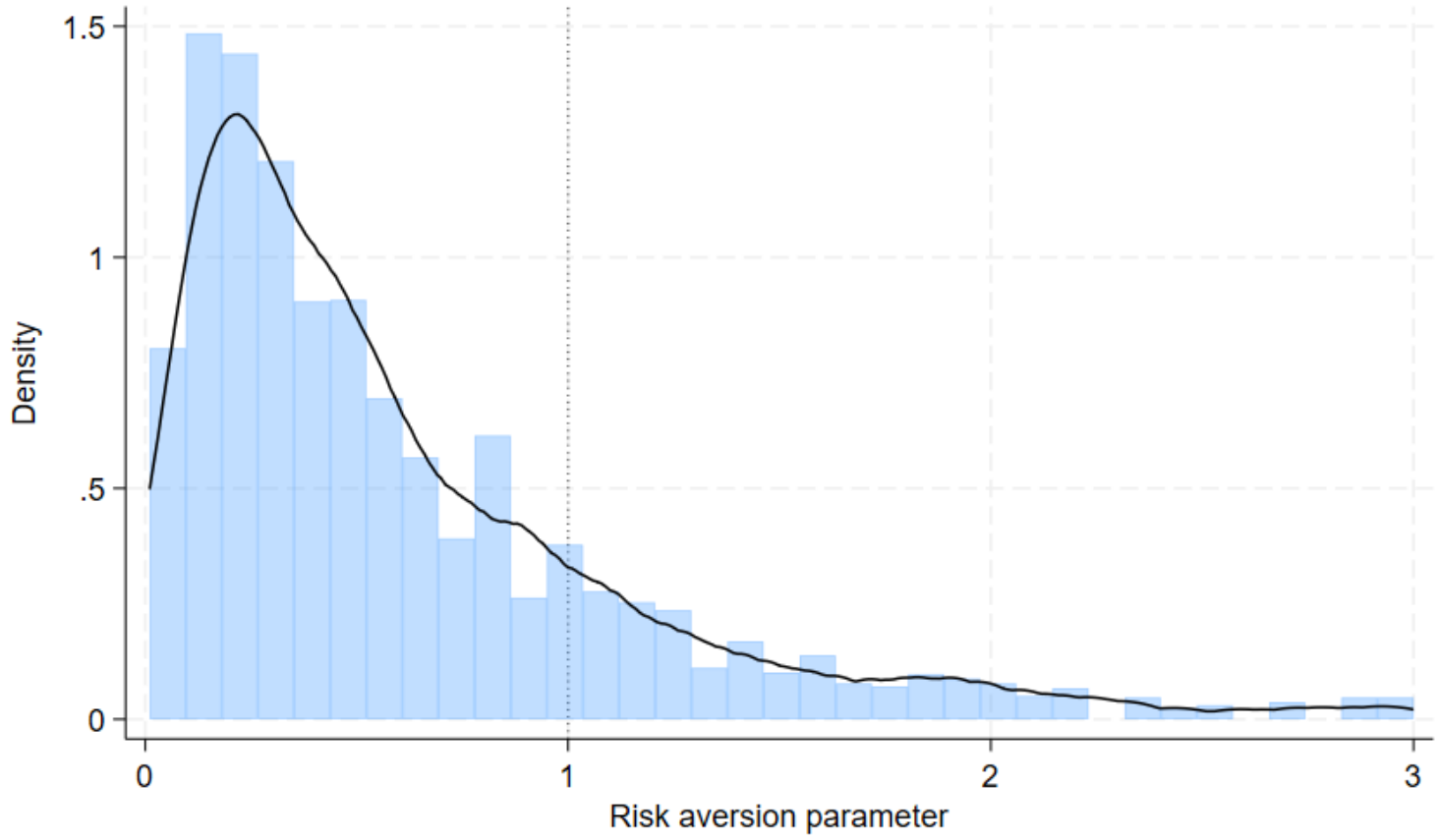

3rd BRET-Tickets

Notes: Based on the CRRA utility function $u(k) = k^r$, where k is the number of boxes collected in the Bomb Risk Elicitation Task (BRET). For ease of illustration, the range of parameter values shown is restricted to $r \leq 3$. The red dotted line indicates the risk aversion parameter of risk neutrality ($r = 1$). Parameter values smaller (greater) than $r = 1$ indicate risk aversion (risk loving). The figure is based on first-round choices in the BRET.

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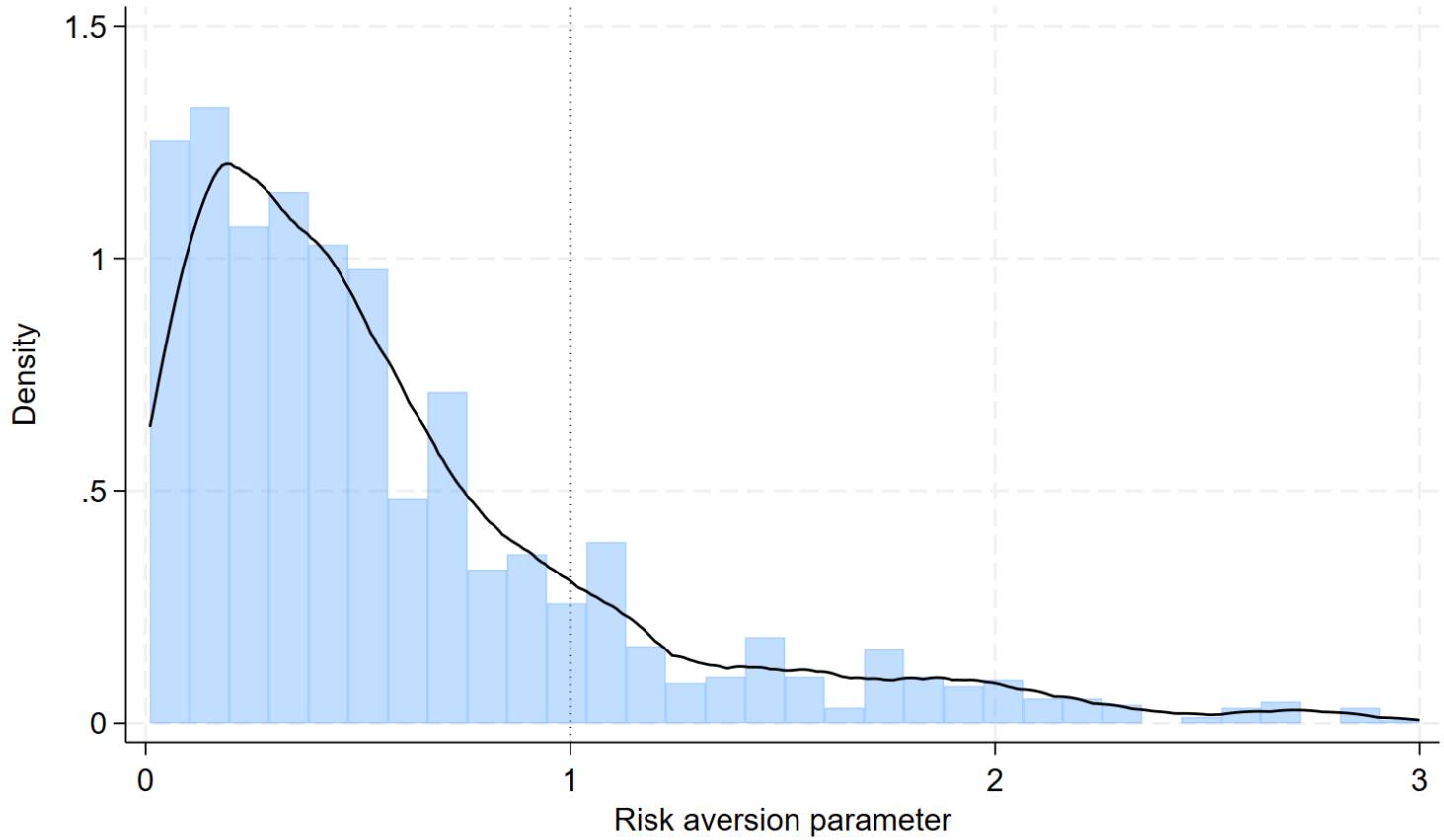

1st BRET-Discount

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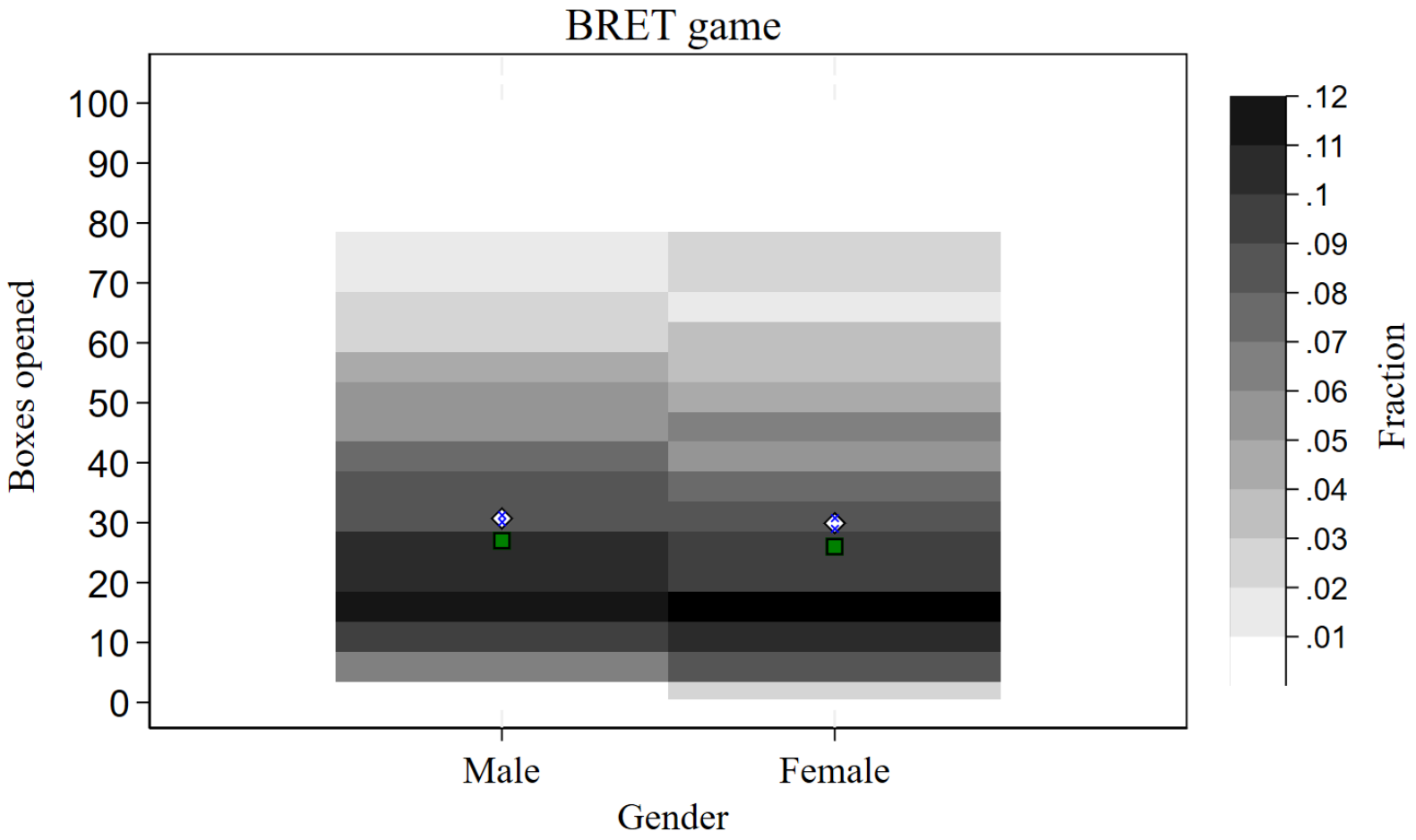
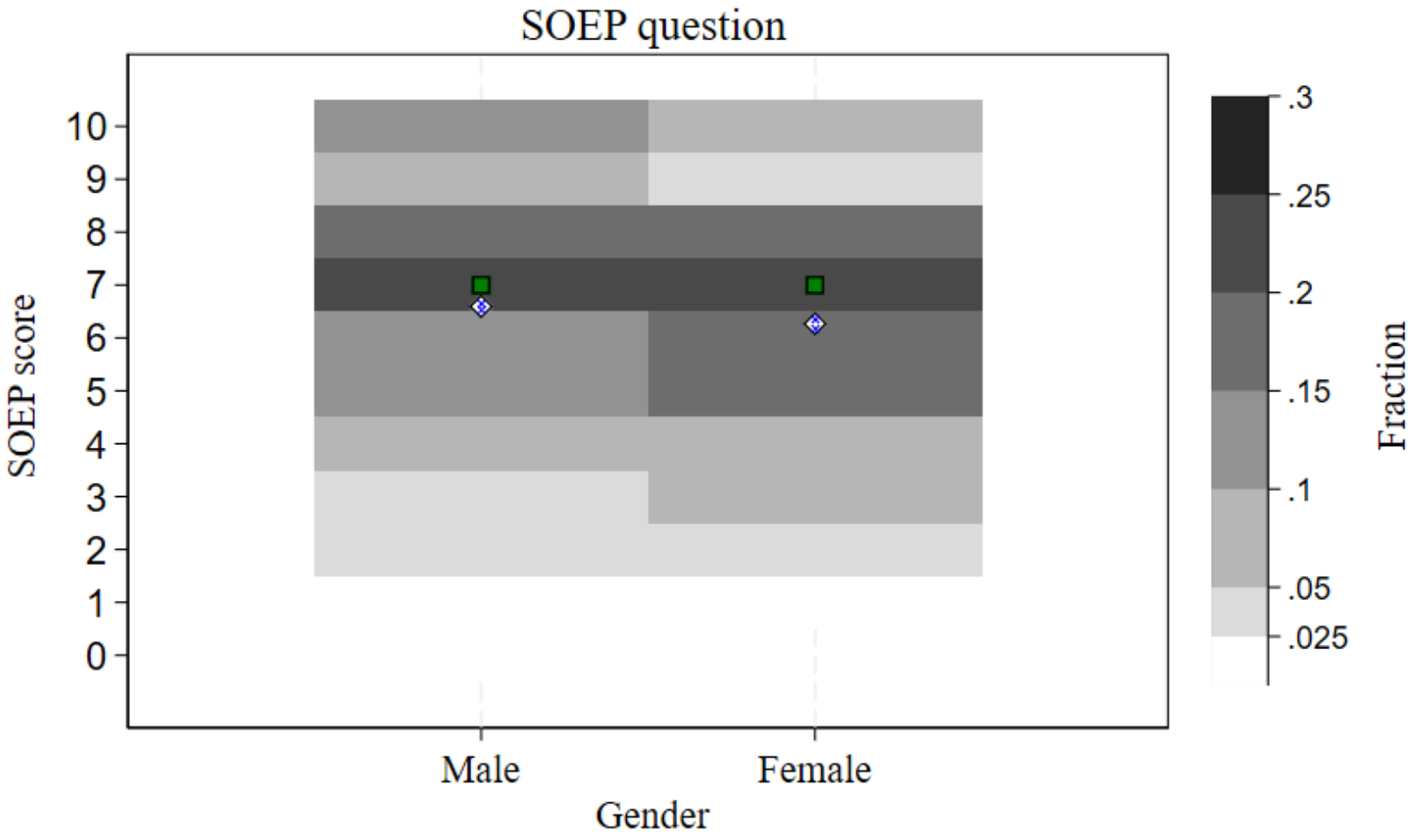
Gender differences: BRET [1st round]



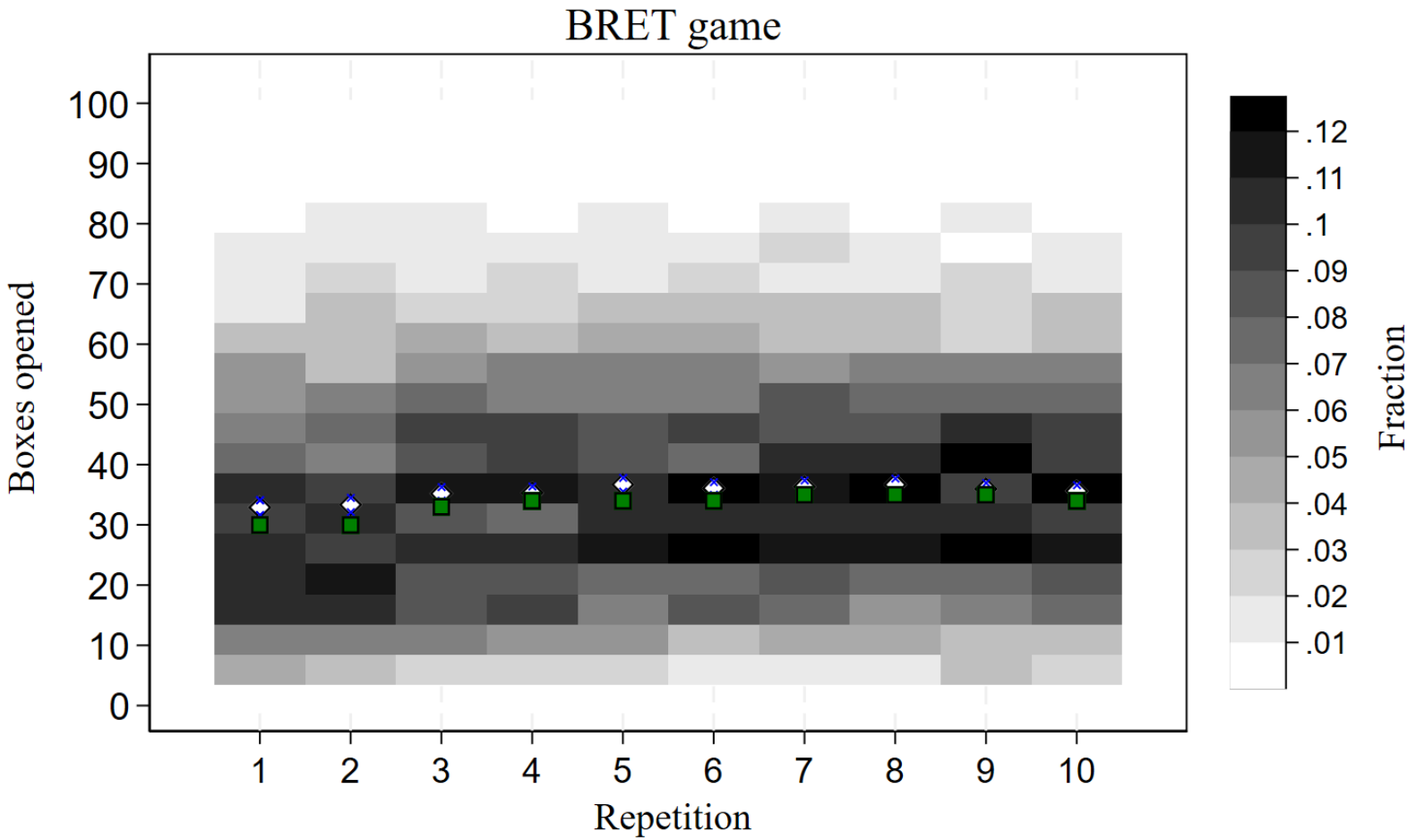
Notes: Based on first-round decisions in the Bomb Risk Elicitation Task (BRET). The white diamonds (◇) and the green squares (□) denote the average and median values, respectively.

Gender differences: SOEP [1st round]



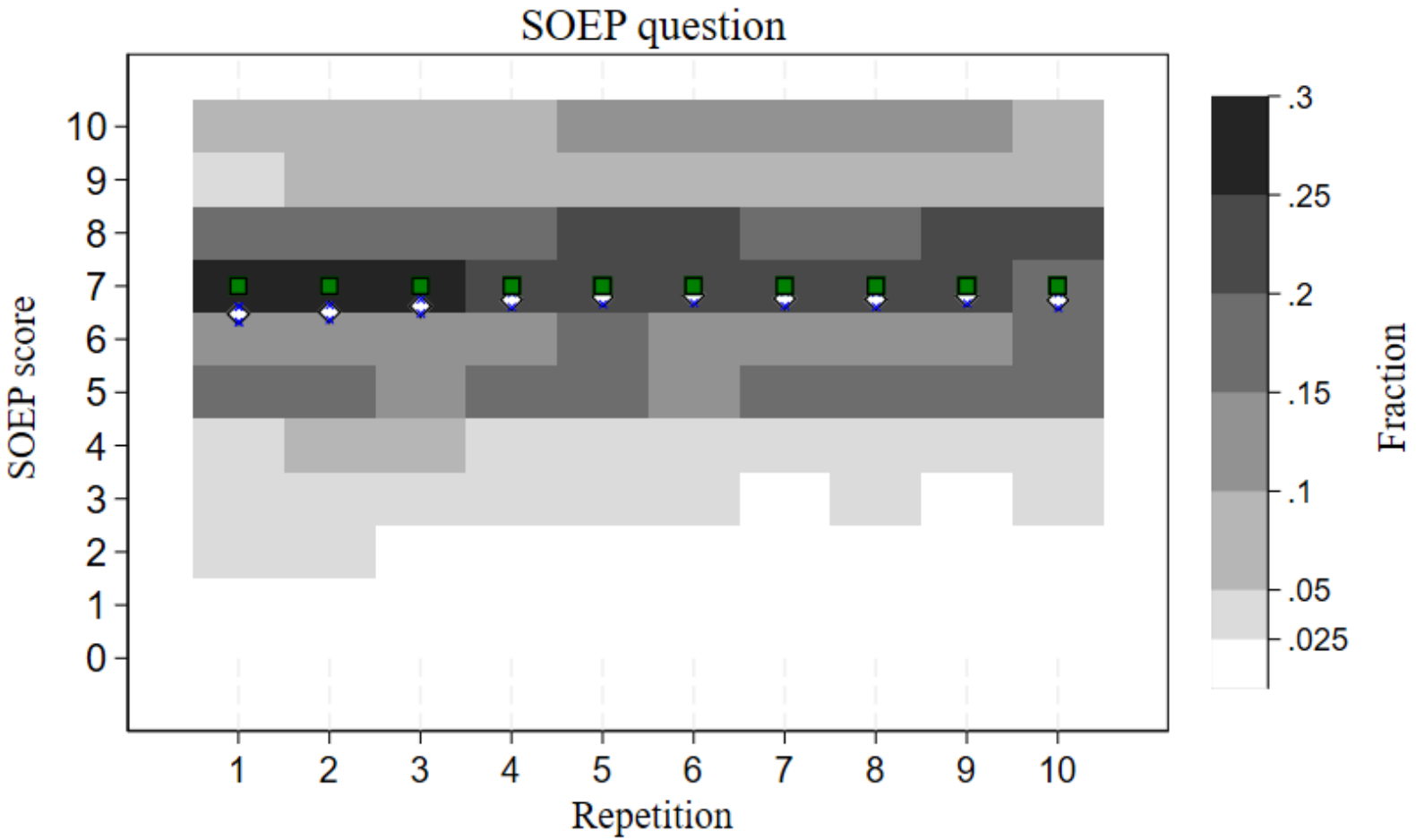
Notes: First-round responses to the SOEP question on willingness to take risks in general. Responses are measured on an eleven-point scale from 0 (not at all willing to take risks) to 10 (very willing to take risks). The white diamonds (◇) and the green squares (□) denote the average and median values, respectively.

Choice Behavior in Repeated Rounds: BRET



Notes: Summary of decisions across repetitions: Bomb Risk Elicitation Task (BRET). Responses are measured on an eleven-point scale from 0 (not at all willing to take risks) to 10 (very willing to take risks). The white diamonds (◇) and the green squares (□) denote the average and median values, respectively.

Choice Behavior in Repeated Rounds: SOEP



Notes: Summary of decisions across repetitions: SOEP Question. Responses are measured on an eleven-point scale from 0 (not at all willing to take risks) to 10 (very willing to take risks). The white diamonds (◇) and the green squares (□) denote the average and median values, respectively.

BRET and SOEP responses: correlation

#th round	ρ	H_0: $\rho = 0$	N
1st	0.0263	0.0656	4,916
2nd	0.0467	0.0040	3,794
3rd	0.0582	0.0015	2,976
4th	0.0309	0.1304	2,405
5th	0.0310	0.1667	1,995
All	0.0579	0.0000	27,021

- Similar to Crosetto and Filippin (2016, EE) who find $\hat{\rho} = 0.03$.

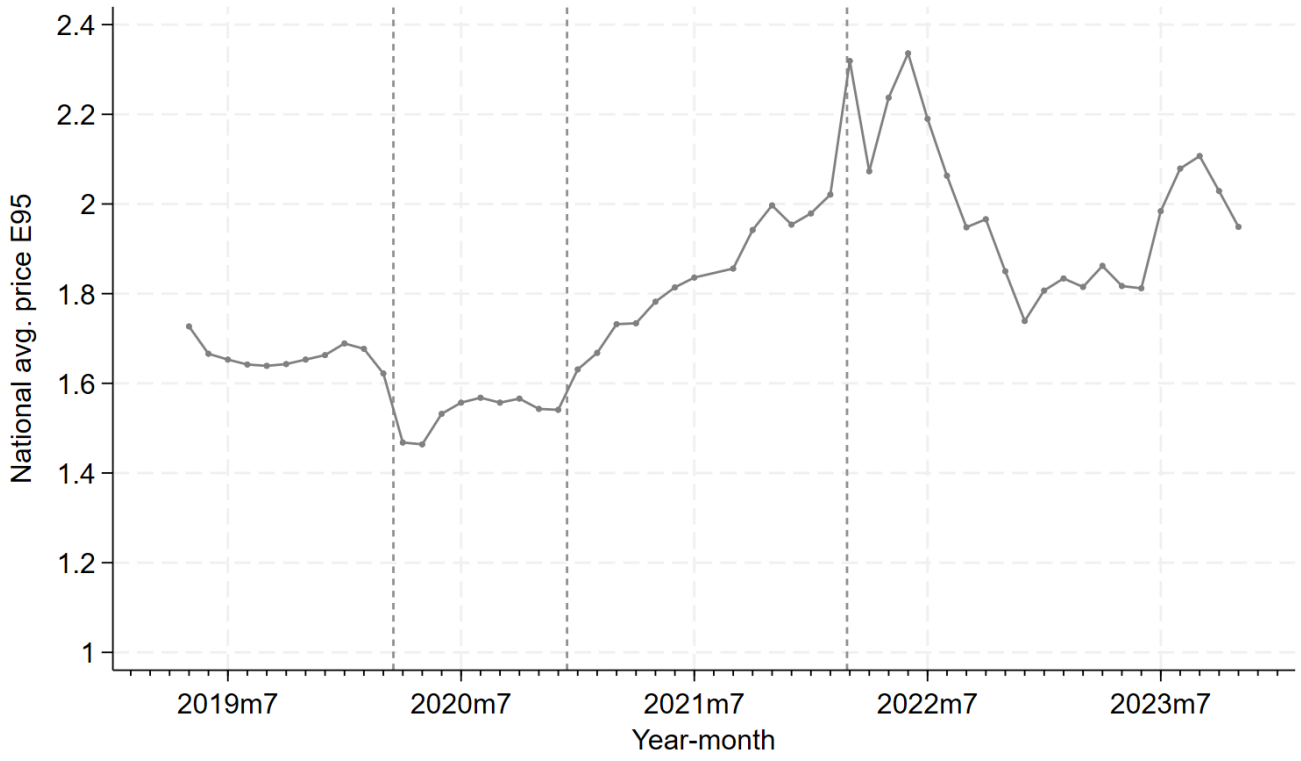
▸ RepeatedPlay

BRET and SOEP and Demographics

Dep. var.	BRET boxes			SOEP score		
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-1.189*	-1.372***	-0.660*	-0.297***	-0.205***	-0.134***
	(0.705)	(0.275)	(0.356)	(0.072)	(0.031)	(0.040)
Low veh. value	-0.205	-1.061***	-1.271***	0.028	0.008	-0.018
	(0.780)	(0.290)	(0.377)	(0.080)	(0.032)	(0.043)
High veh. value	0.347	0.535	0.230	0.316***	0.297***	0.393***
	(0.811)	(0.338)	(0.434)	(0.084)	(0.038)	(0.049)
Age			0.397***			-0.036***
			(0.075)			(0.009)
Age^2			-0.004***			0.000***
			(0.001)			(0.000)
Constant	34.157***	32.677***	20.233***	5.811***	5.730***	6.534***
	(3.156)	(2.798)	(4.305)	(0.370)	(0.342)	(0.520)
R^2	0.015	0.022	0.021	0.025	0.013	0.017
Number of obs.	4,165	22,915	13,629	4,083	20,374	12,072
Round(s)	First	All	All	First	All	All
Round fixed effects	–	Yes	Yes	–	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

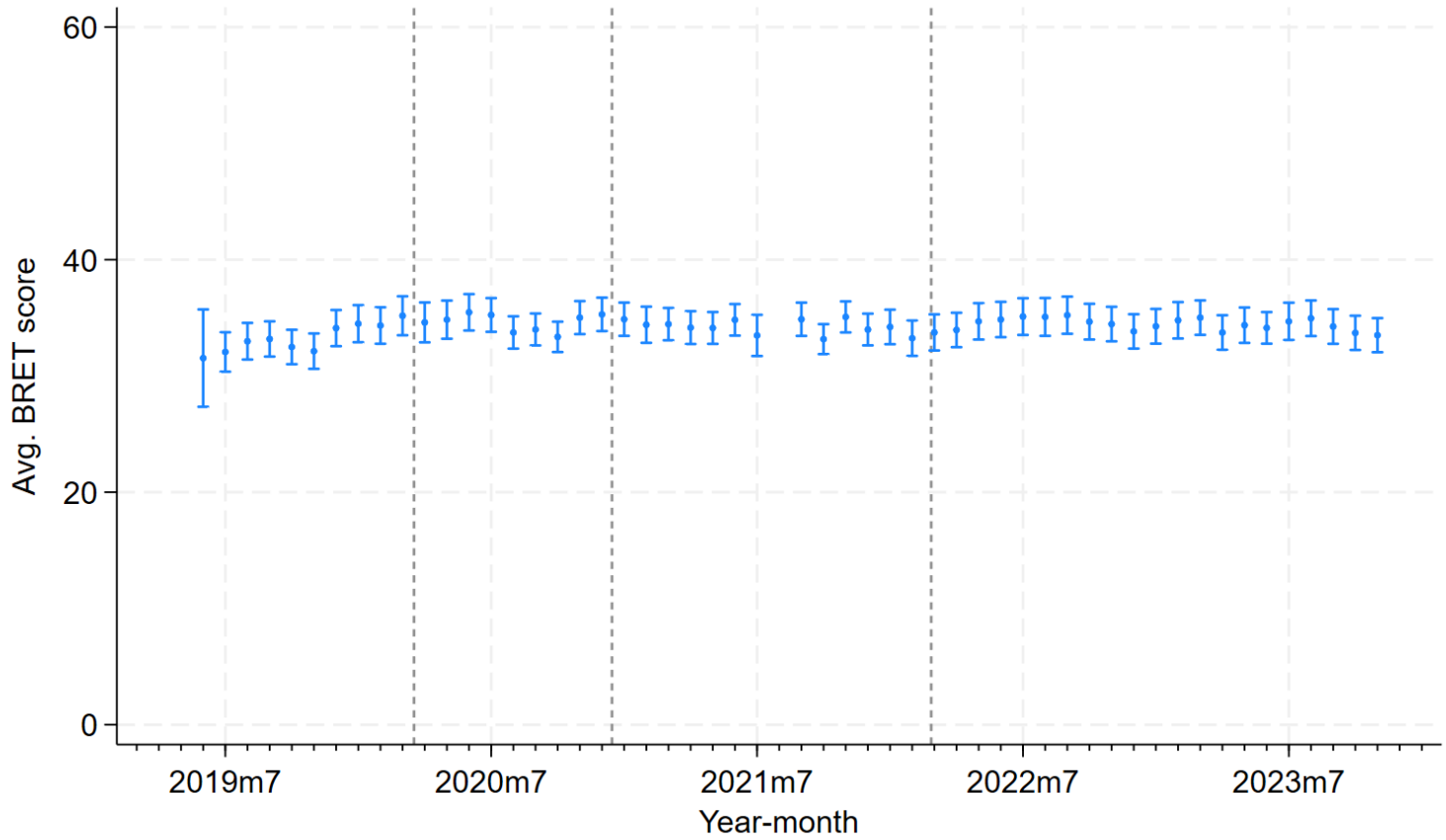
***(**,*) : statistically different from zero at the 1%-level (5%-level, 10%-level). Standard errors in parentheses.

Events and fuel price (E95) in this period



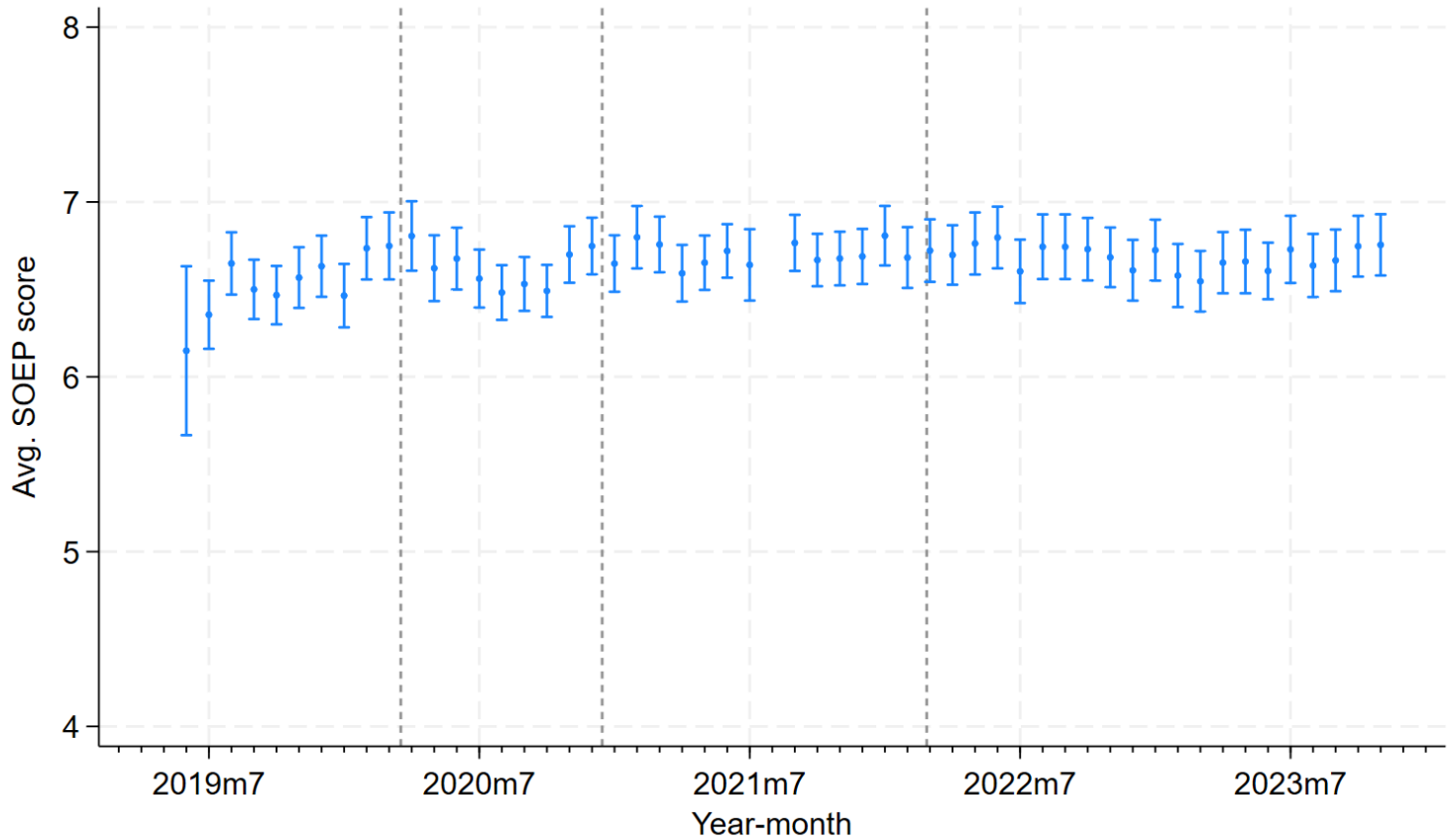
- **16/03/20-11/04/20**: First lockdown. Primary schools closed
- **14/12/20-07/02/21**: Second lockdown. Primary schools closed
- **24/02/22**: Russia invades Ukraine.

BRET: Average number of boxes collected over time



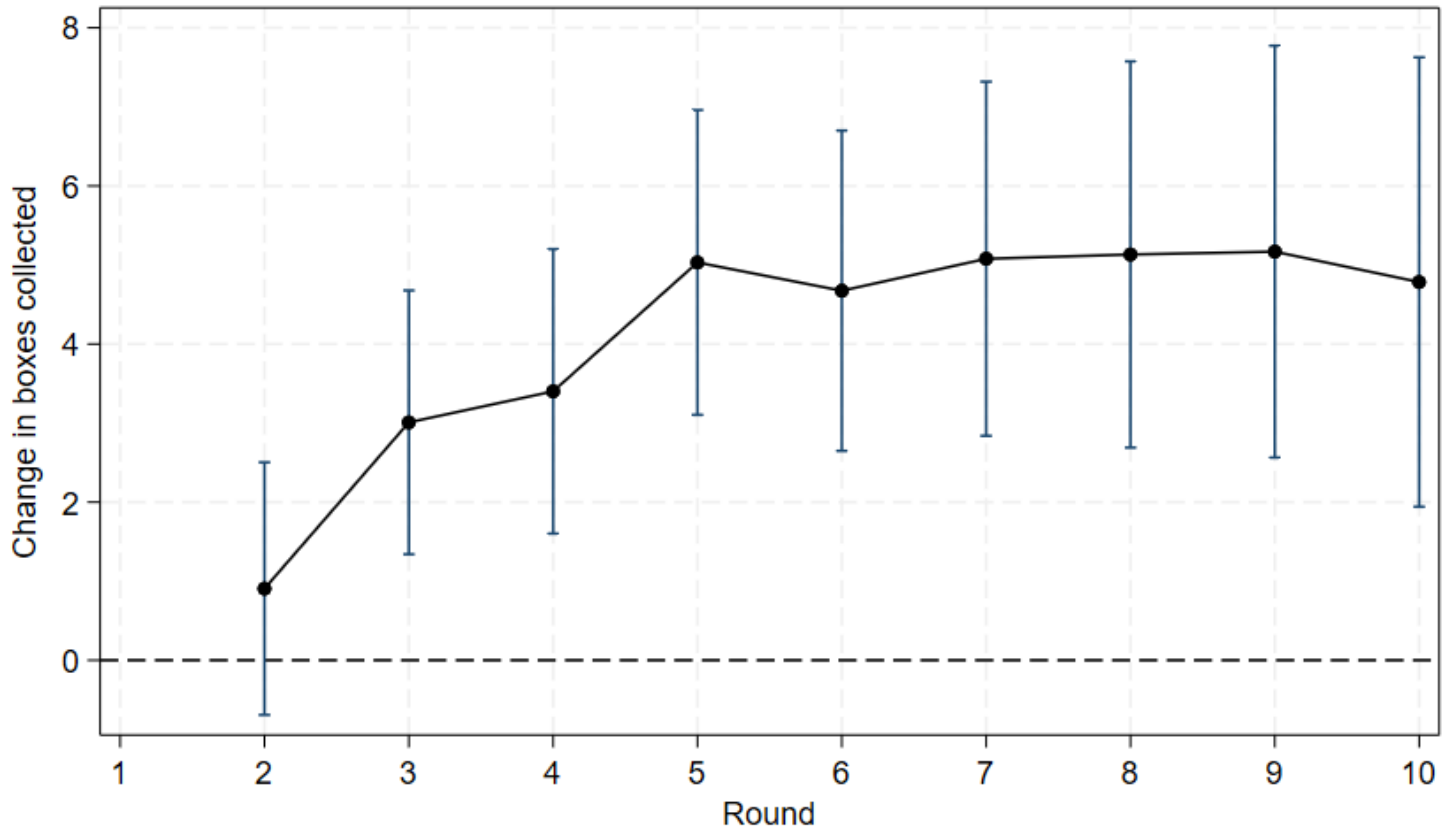
Notes: The figure shows the monthly average number of boxes collected in the Bomb Risk Elicitation Task (BRET) in the sample period, with 95% CI. The sample period started on 26 February 2019 with a four-month pilot phase at one filling station. On 27 June 2019 the BRET was rolled out over all filling stations in the Netherlands. Over time, some new stations were opened and added to the sample.

SOEP: Average response over time



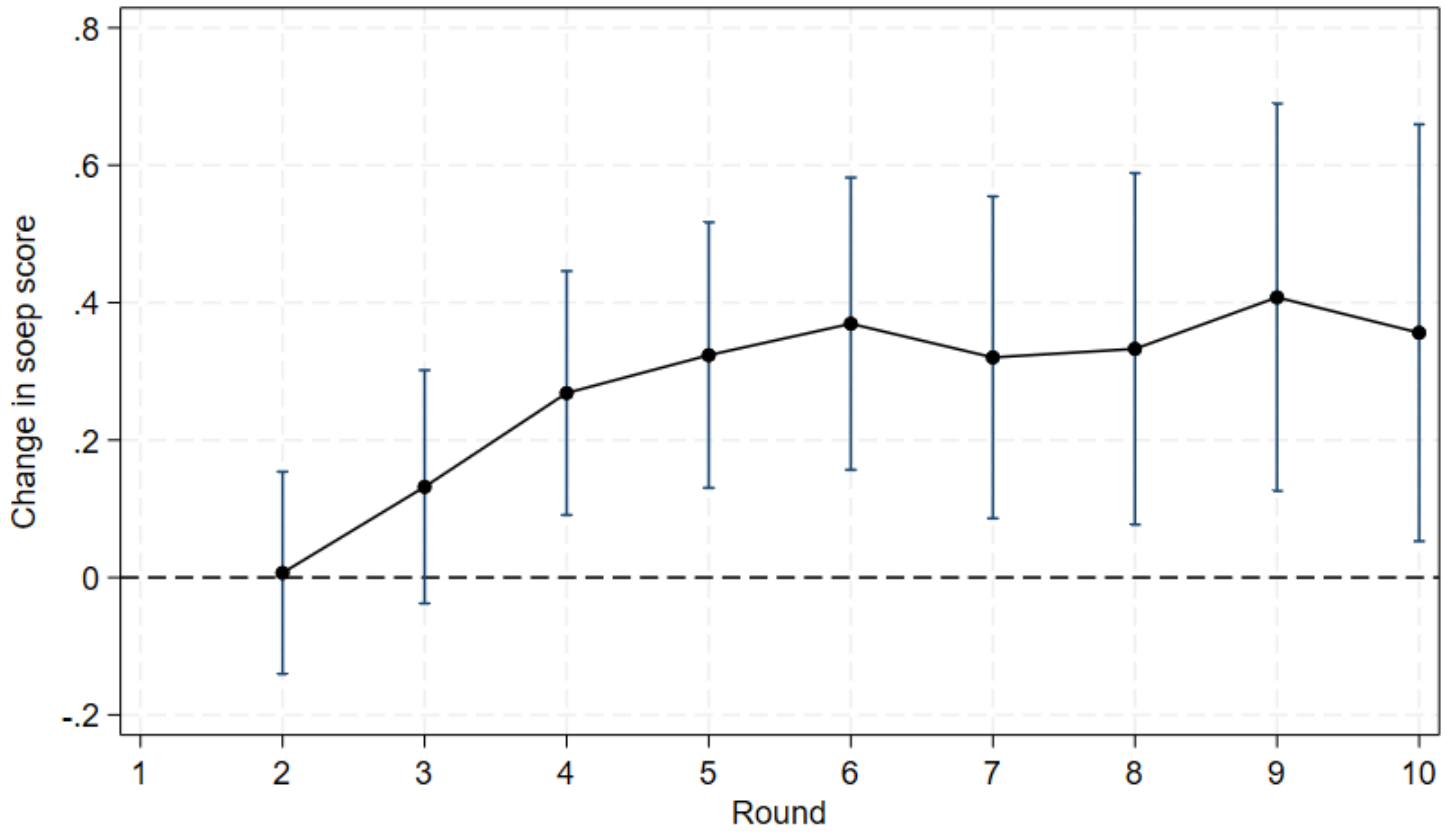
Notes: The figure shows the monthly average response given to the SOEP risk question in the sample period. The sample period started on 26 February 2019 with a four-month pilot phase at one filling station. On 27 June 2019 the BRET was rolled out over all filling stations in the Netherlands. Over time, some new stations were opened and added to the sample.

Within-Subject Changes in Behavior per Round – BRET



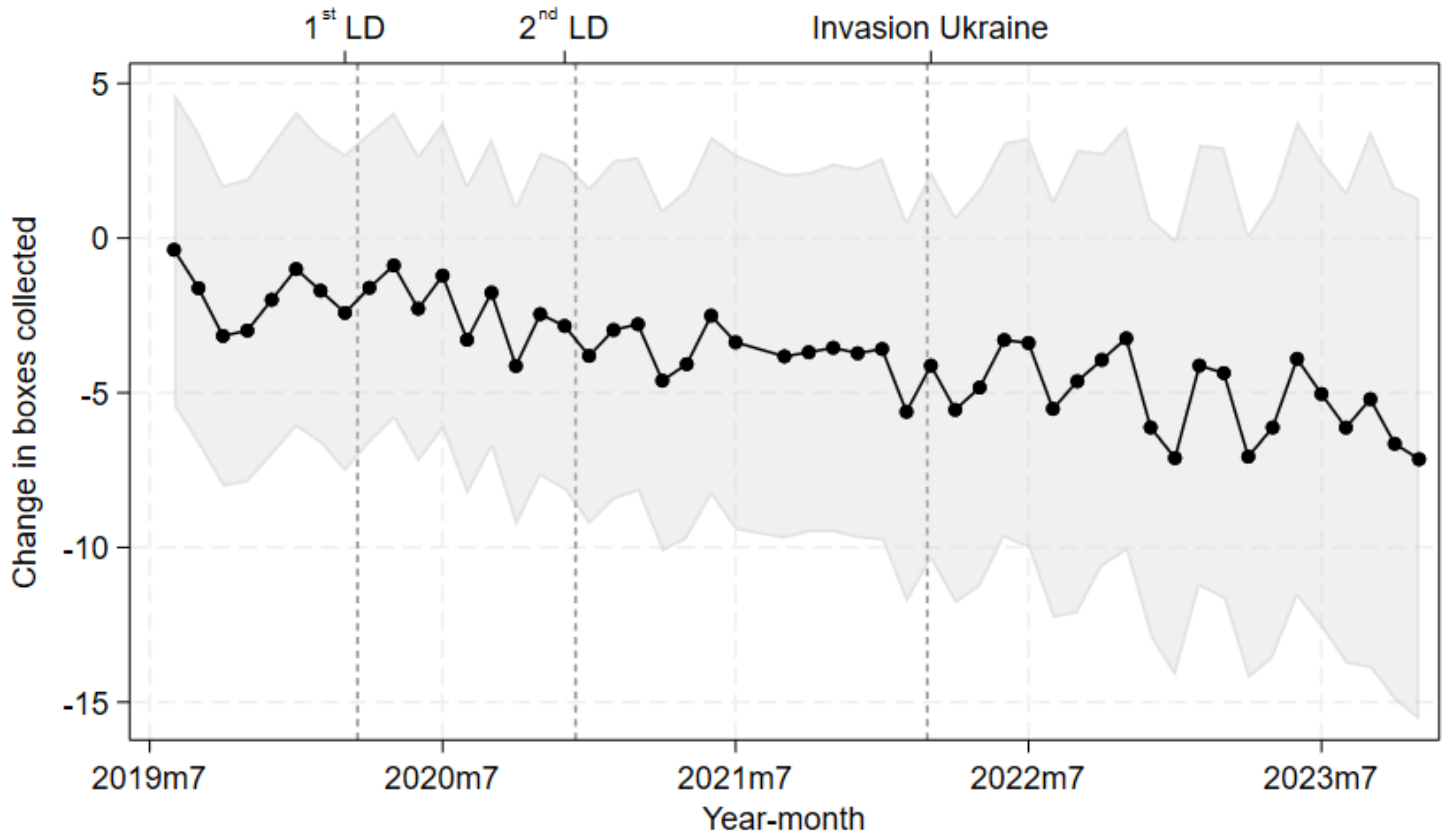
Notes: Changes in behavior compared to the first round in the Bomb Risk Elicitation Task (BRET). The regressions control for driver and time fixed effects. The sample includes subjects who completed the respective task at least ten times. The vertical spikes indicate 95% confidence intervals.

Within-Subject Changes in Behavior per Round – SOEP



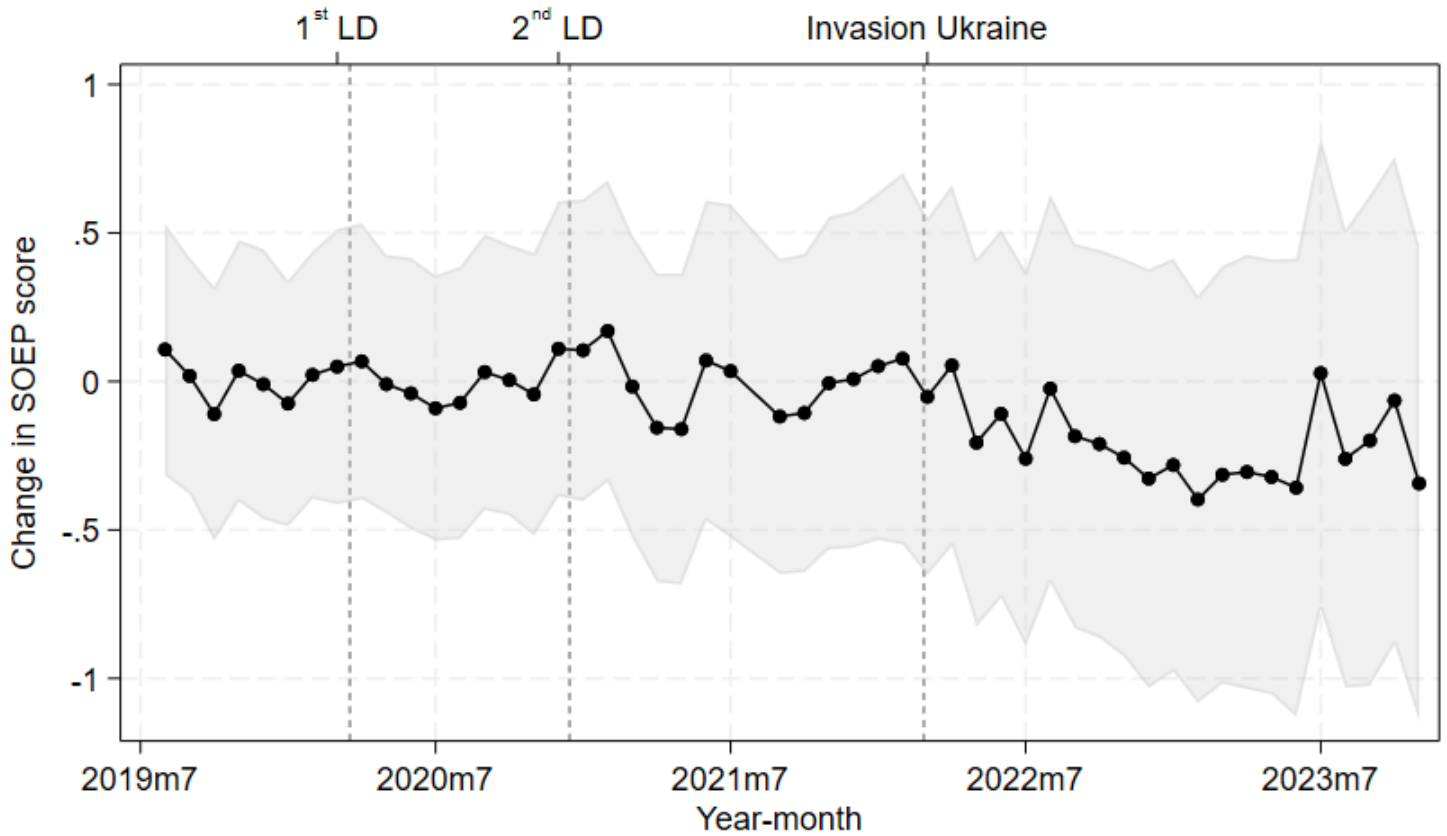
Notes: Changes in behavior compared to the first round in the general risk question from the German Socio-Economic Panel. The regressions control for driver and time fixed effects. The sample includes subjects who completed the respective task at least ten times. The vertical spikes indicate 95% confidence intervals.

Within-Subject Changes in Behavior per Month – BRET



Notes: Changes in behavior compared to the first month of the sample period (July 2019) in the Bomb Risk Elicitation Task (BRET). The regressions control for driver and round fixed effects. The sample includes subjects who completed the respective task at least ten times. The shaded areas indicate 95% confidence intervals. The dashed vertical lines indicate major events during the sample period. The first two events are the first (starting 16 March 2020) and second (14 December 2020) lockdown in the Netherlands due to the COVID-19 pandemic. The third major event is the start of the war in Ukraine on 24 February 2022.

Within-Subject Changes in Behavior per Month – SOEP



Notes: Changes in behavior compared to the first month of the sample period (July 2019) in the general risk question from the German Socio-Economic Panel. The regressions control for driver and round fixed effects. The sample includes subjects who completed the respective task at least ten times. The shaded areas indicate 95% confidence intervals. The dashed vertical lines indicate major events during the sample period. The first two events are the first (starting 16 March 2020) and second (14 December 2020) lockdown in the Netherlands due to the COVID-19 pandemic. The third major event is the start of the war in Ukraine on 24 February 2022.

BRET: Tickets vs. Discount?

	(1)	(2)	(3)
Discount	0.906	0.927	0.555
	(1.082)	(0.574)	(0.575)
Time spent on instructions			0.375***
			(0.055)
Constant	26.079***	28.386***	26.515***
	(3.506)	(1.509)	(1.535)
R^2	0.012	0.013	0.018
Number of obs.	1,470	10,586	10,586
Round	First	All	All
Round fixed effects	n.a.	Yes	Yes
Month fixed effects	Yes	Yes	Yes

▶ Graph

Notes: Reported estimates are from OLS regressions with the number of boxes collected by subjects in the first round of the Bomb Risk Elicitation Task (BRET) as the dependent variable. Discount is a dummy variable equal to 1 if a subject completed the BRET version in which a parking discount could be earned, 0 if the default BRET version for prize draw tickets is completed. Time spent on reading the BRET instructions is in seconds. The sample consists of subjects who completed the BRET (Ticket or Discount) in the period that the Discount treatment is rolled out (from 22 August 2022 onwards).
***(**,*) : statistically different from zero at the 1%-level (5%-level, 10%-level). Standard errors in parentheses.

Summary

- The **weak but positive** correlation between BRET and SOEP scores replicates in the field
- Events such as COVID and the war in Europe **did not** affect general risk attitudes
- BRET and SOEP scores correlate in the same way with gender, but differently with vehicle value
- Short and 'fun' games such as the BRET can be effectively used to create large panels with that track people's risk preferences frequently over a long period

Thank you for your attention!

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References

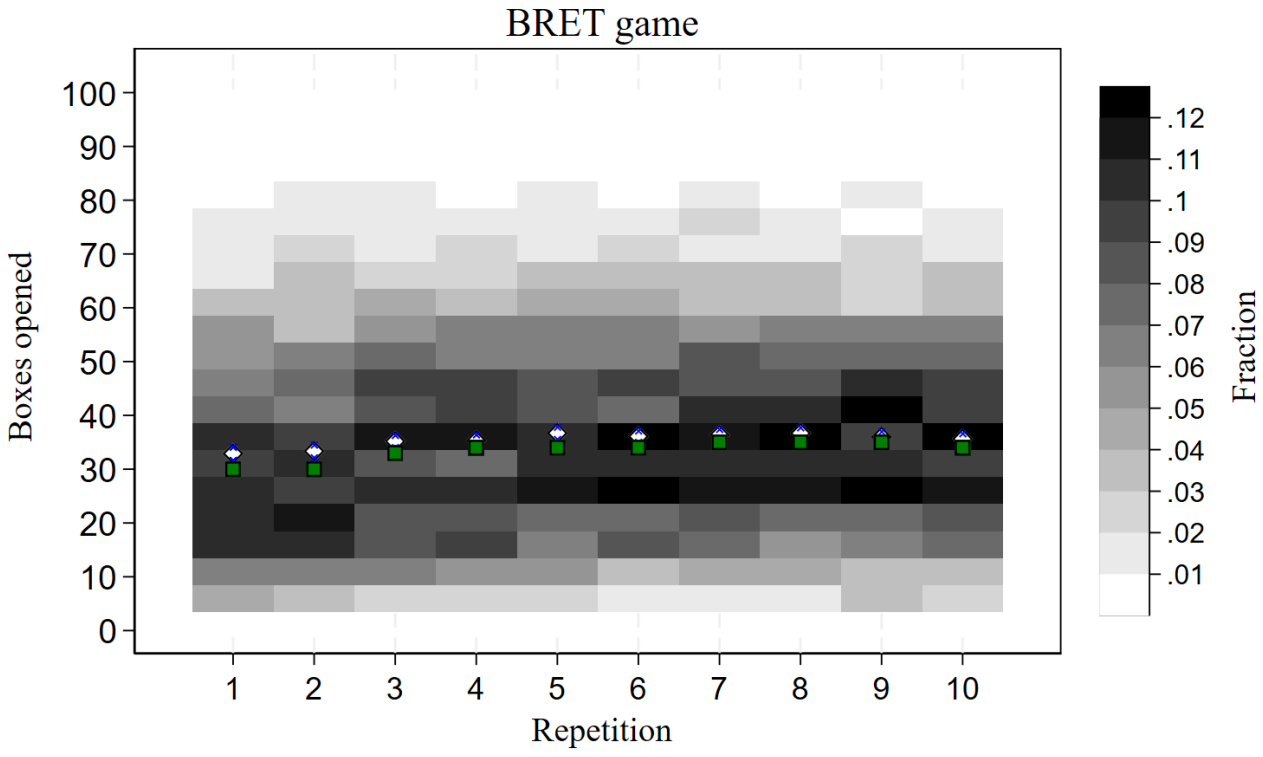
BRET - Crosetto and Filippin (2013)

- Subjects choose a number $k \in [0, 100]$, i.e. number of boxes to open.
- Assuming a CRRA utility function:

$$u(k) = k^r \Rightarrow k^* = 100\frac{r}{1+r}.$$

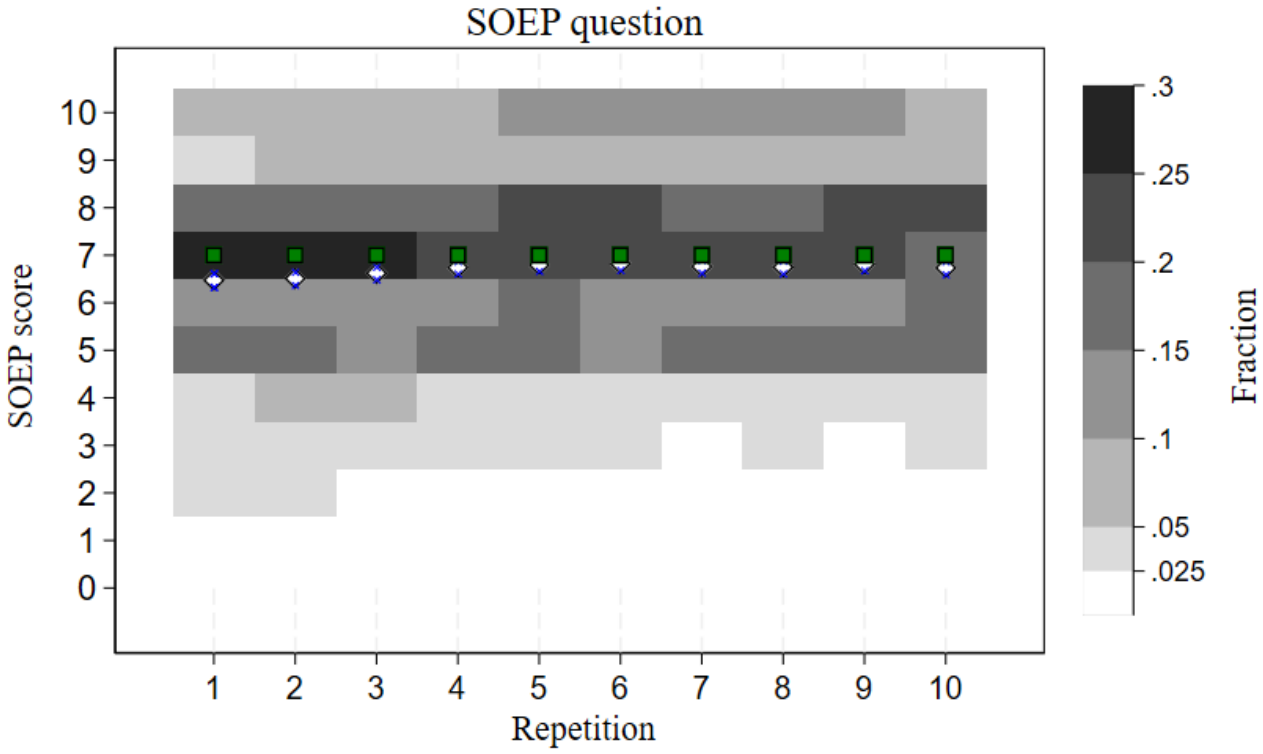
$$k = \begin{cases} < 50 & \text{if } r < 1 \\ 50 & \text{if } r = 1 \\ > 50 & \text{if } r > 1 \end{cases}$$

Repeated Play BRET and SOEP



Notes: Sample only includes respondents who have played BRET at least 10 times. The white diamonds (◇) and the green squares (□) denote the average and median values, respectively.

Repeated Play BRET and SOEP



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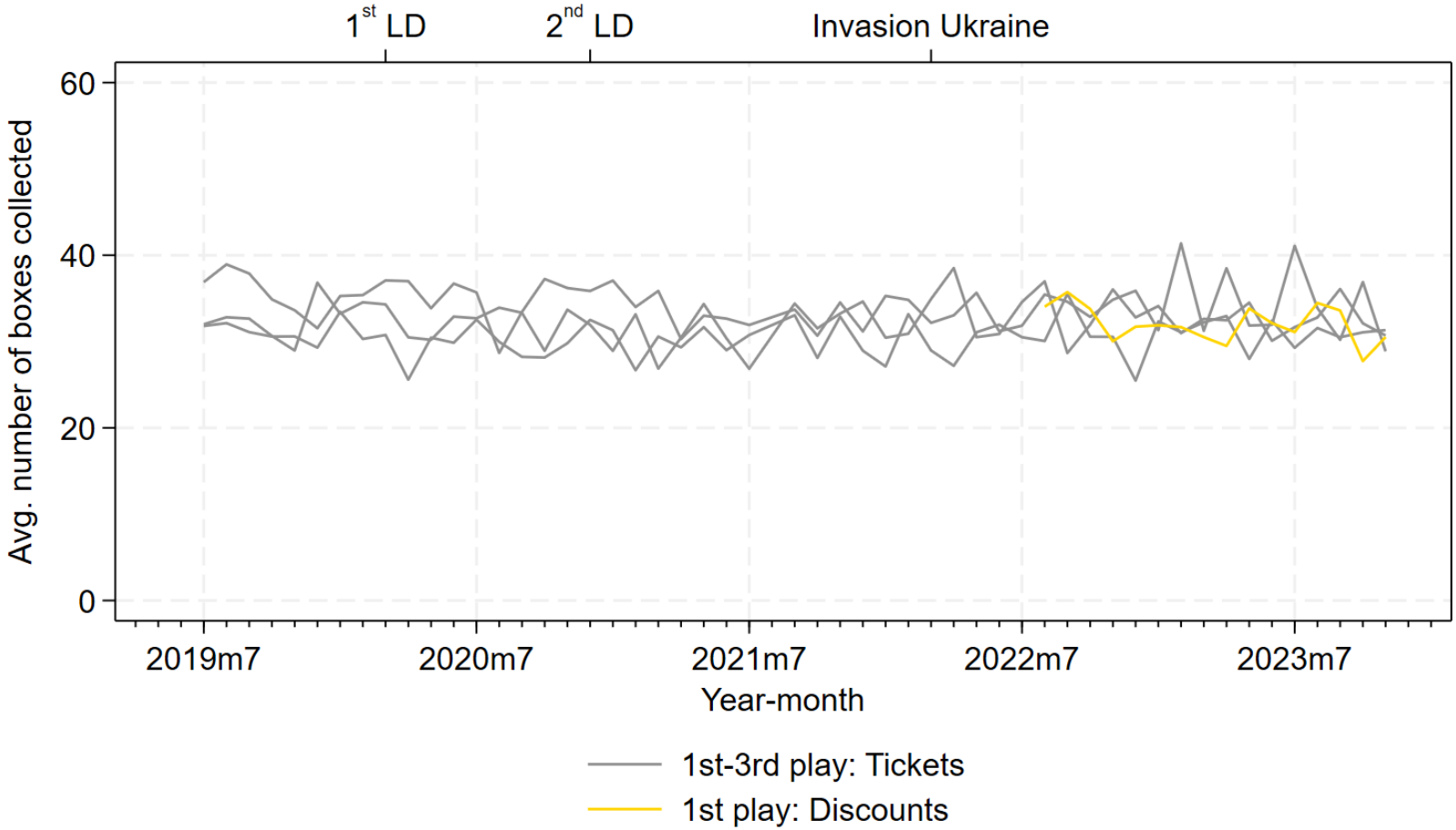
◂ return

Station Information

				BRET Tickets		SOEP	BRET Discount	
	Location	First Date	Final Date	offered	played	played	offered	played
1.	Appelscha	28/06/2019	11/12/2023	5661	1707	1527	526	101
2.	BergenOpZoom	27/06/2019	04/12/2023	5715	1336	1217	945	122
3.	Bergum	26/11/2020	04/12/2023	2564	556	538	908	113
4.	Bleiswijk	27/06/2019	16/01/2022	8019	1855	1458	0	0
5.	Dalfsen	27/06/2019	04/12/2023	4973	1597	1433	691	108
6.	Elspeet	08/06/2022	04/12/2023	1029	108	141	952	74
7.	Franeker	26/02/2019	04/12/2023	37477	6324	5511	1617	296
8.	Grijpskerk	28/06/2019	04/12/2023	3012	1119	1010	290	67
9.	Heerlen	27/06/2019	04/12/2023	3495	1160	1042	418	82
10.	Hommerts	28/03/2020	11/12/2023	2941	653	604	438	45
11.	Landgraaf	27/06/2019	04/12/2023	7539	1690	1578	1143	161
12.	Leeuwarden	28/06/2019	04/12/2023	4150	1079	926	345	82
13.	Mussel	13/04/2020	10/12/2023	923	302	297	174	38
14.	Nieuwehorne	16/10/2022	04/12/2023	642	62	89	544	50
15.	Ommen	28/06/2019	04/12/2023	7093	2069	1793	834	112
16.	Parrega	10/07/2022	04/12/2023	1238	128	172	1301	94
17.	Putten	28/06/2019	11/12/2023	8105	2257	1993	0	0
18.	Schinnen	28/10/2023	08/12/2023	8	1	2	2	2
19.	Schoonebeek	04/04/2020	11/12/2023	1319	309	302	559	45
20.	Schoonhoven	29/04/2020	04/12/2023	27230	5884	4942	3363	492
21.	SintAnnaparochie	27/06/2019	04/12/2023	10849	3174	2734	358	88
22.	Westergeest	20/12/2019	04/12/2023	2919	581	513	501	52
23.	Zwaagwesteinde	25/11/2021	04/12/2023	2403	513	514	1037	118
	Total			149304	34464	30336	16946	2342

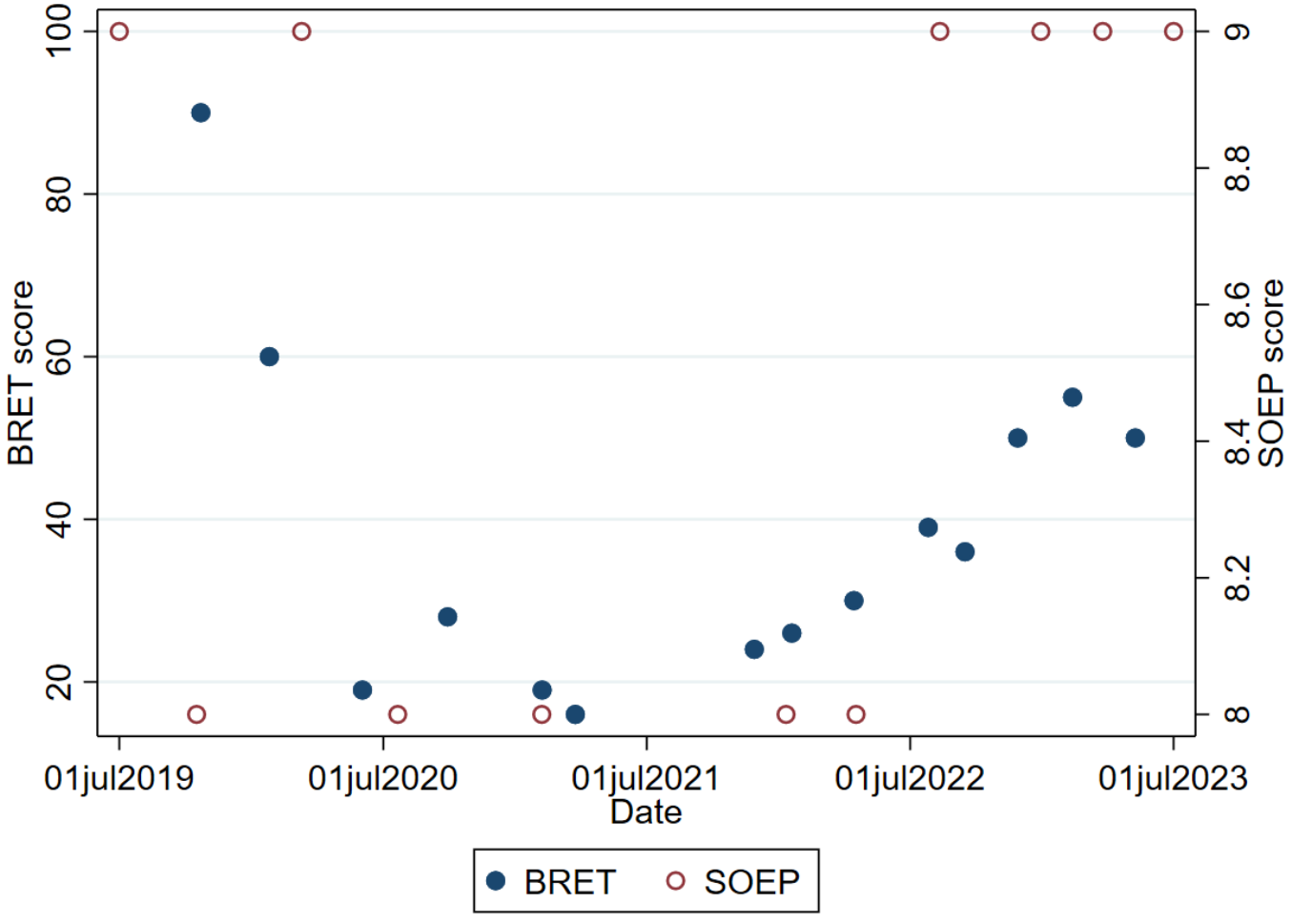
◂ return

BRET: Tickets vs. Discount [Monthly Average Number of Boxes Collected]



Notes: The figure shows the monthly average number of boxes collected in the Bomb Risk Elicitation Task (BRET) in the sample period for respondents who played for discounts (yellow line) instead of tickets (1st, 2nd and 3rd time, gray lines).

Example of one customer



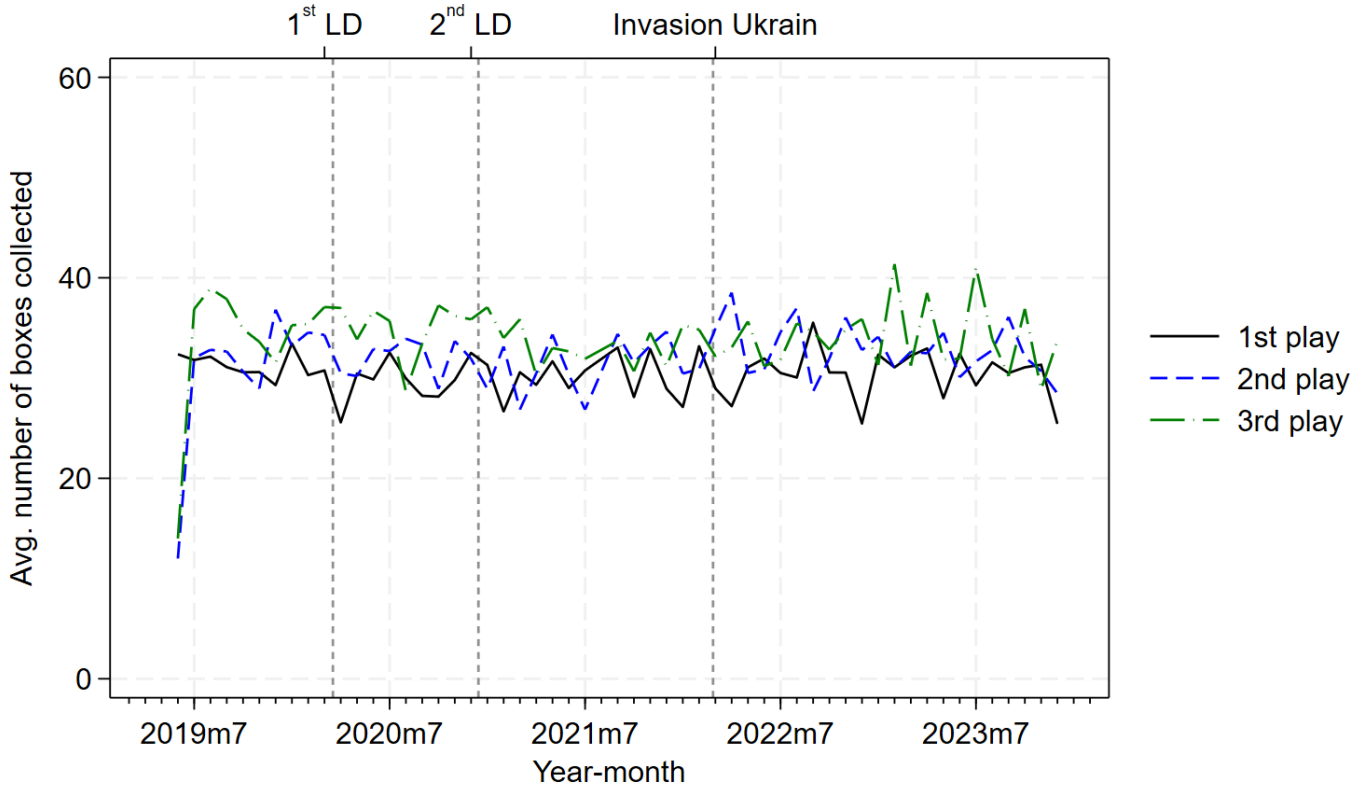
return

When do people decline to play?

```
. areg declined  b9.startHOUR, absorb(ID) cluster(ID)

Linear regression, absorbing indicators          Number of obs     = 149,304
Absorbed variable: ID                            No. of categories =  10,952
                                                 F(23, 10951)      =   10.71
                                                 Prob > F          =  0.0000
                                                 R-squared         =  0.4490
                                                 Adj R-squared     =  0.4053
                                                 Root MSE          =  0.3324

                                    (Std. err. adjusted for 10,952 clusters in ID)
------------------------------------------------------------------------------
             |               Robust
    declined | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
   startHOUR |
           0 |   -.065513   .0227105    -2.88   0.004    -.1100298   -.0209963
           1 |  -.0839421   .0366707    -2.29   0.022    -.1558234   -.0120608
           2 |   .0080515   .0410188     0.20   0.844    -.0723529    .0884558
           3 |  -.0189425   .0299824    -0.63   0.528    -.0777134    .0398283
           4 |  -.0223361   .0212401    -1.05   0.293    -.0639705    .0192982
           5 |   .0250977   .0171703     1.46   0.144    -.0085592    .0587546
           6 |   .0178138   .0079412     2.24   0.025     .0022476    .0333801
           7 |   .0161784   .0062948     2.57   0.010     .0038394    .0285174
           8 |   .0007671   .0055059     0.14   0.889    -.0100254    .0115596
          10 |  -.0203764   .0051885    -3.93   0.000    -.0305467   -.0102061
          11 |  -.0200473   .0053056    -3.78   0.000    -.0304472   -.0096474
          12 |  -.0202659   .0055424    -3.66   0.000      -.03113   -.0094019
          13 |  -.0162676   .0052044    -3.13   0.002    -.0264691   -.0060661
          14 |  -.0123785   .0052406    -2.36   0.018    -.0226511    -.002106
          15 |   -.012929   .0052321    -2.47   0.013    -.0231848   -.0026732
          16 |  -.0210669   .0050804    -4.15   0.000    -.0310253   -.0111084
          17 |  -.0181722   .0051714    -3.51   0.000    -.0283091   -.0080353
          18 |  -.0317744   .0058821    -5.40   0.000    -.0433044   -.0202444
          19 |  -.0427025   .0060199    -7.09   0.000    -.0545026   -.0309025
          20 |  -.0528416   .0067862    -7.79   0.000    -.0661438   -.0395394
          21 |  -.0643173   .0079933    -8.05   0.000    -.0799857    -.048649
          22 |  -.0603019   .0098699    -6.11   0.000    -.0796487   -.0409551
          23 |  -.0690592   .0149699    -4.61   0.000    -.0984029   -.0397155

       _cons |   .7719055   .0037793   204.25   0.000     .7644975    .7793135
------------------------------------------------------------------------------
```

☞Especially between 6-9am.

Average number of boxes collected in the BRET – rounds 1–3



Notes: The figure shows the monthly average number of boxes collected in the Bomb Risk Elicitation Task (BRET) in the sample period. The sample period started on 26 February 2019 with a four-month pilot phase at one filling station. On 27 June 2019 the BRET was rolled out over all filling stations in the Netherlands. Over time, some new stations were opened and added to the sample.