Appendices

Appendix A. Design of experiment

Table A1 Design of time preferences experiment

	Option A	Option B		Option A	Option B		Option A	Option B
	Series 1			Series 2			Series 3	
1	4 ¥	24 ¥ in 1 week	6	4 ¥	24 ¥ in 1 month	11	4 ¥	24 ¥ in 3 month
2	8 ¥	24 ¥ in 1 week	7	8 ¥	24 ¥ in 1 month	12	8 ¥	24 ¥ in 3 month
3	12 ¥	24 ¥ in 1 week	8	12 ¥	24 ¥ in 1 month	13	12 ¥	24 ¥ in 3 month
4	16 ¥	24 ¥ in 1 week	9	16 ¥	24 ¥ in 1 month	14	16 ¥	24 ¥ in 3 month
5	20 ¥	24 ¥ in 1 week	10	20 ¥	24 ¥ in 1 month	15	20 ¥	24 ¥ in 3 month
	Series 4			Series 5			Series 6	
16	10 ¥	60 ¥ in 1 week	21	10 ¥	60 ¥ in 1 month	26	10 ¥	60 ¥ in 3 months
17	20 ¥	60 ¥ in 1 week	22	20 ¥	60 ¥ in 1 month	27	20 ¥	60 ¥ in 3 months
18	30 ¥	60 ¥ in 1 week	23	30 ¥	60 ¥ in 1 month	28	30 ¥	60 ¥ in 3 months
19	40 ¥	60 ¥ in 1 week	24	40 ¥	60 ¥ in 1 month	29	40 ¥	60 ¥ in 3 months
20	50 ¥	60 ¥ in 1 week	25	50 ¥	60 ¥ in 1 month	30	50 ¥	60 ¥ in 3 months
	Series 7			Series 8			Series 9	
31	1 ¥	6 ¥ in 1 week	36	1 ¥	6 ¥ in 1 month	41	1 ¥	6 ¥ in 3 months
32	2 ¥	6 ¥ in 1 week	37	2 ¥	6 ¥ in 1 month	42	2 ¥	6 ¥ in 3 months
33	3 ¥	6 ¥ in 1 week	38	3 ¥	6 ¥ in 1 month	43	3 ¥	6 ¥ in 3 months
34	4 ¥	6 ¥ in 1 week	39	4 ¥	6 ¥ in 1 month	44	4 ¥	6 ¥ in 3 months
35	5 ¥	6 ¥ in 1 week	40	5 ¥	6 ¥ in 1 month	45	5 ¥	6 ¥ in 3 months
	Series 10			Series 11			Series 12	
46	8 ¥	48 ¥ in 3 days	51	8 ¥	48 ¥ in 2 weeks	56	8 ¥	48 ¥ in 2 months
47	16 ¥	48 ¥ in 3 days	52	16 ¥	48 ¥ in 2 weeks	57	16 ¥	48 ¥ in 2 months
48	24 ¥	48 ¥ in 3 days	53	24 ¥	48 ¥ in 2 weeks	58	24 ¥	48 ¥ in 2 months
49	32 ¥	48 ¥ in 3 days	54	32 ¥	48 ¥ in 2 weeks	59	32 ¥	48 ¥ in 2 months
50	40 ¥	48 ¥ in 3 days	55	40 ¥	48 ¥ in 2 weeks	60	40 ¥	48 ¥ in 2 months
	Series 13			Series 14			Series 15	
61	2 ¥	12 ¥ in 3 days	66	2 ¥	12 ¥ in 2 weeks	71	2 ¥	12 ¥ in 2 months
62	4 ¥	12 ¥ in 3 days	67	4 ¥	12 ¥ in 2 weeks	72	4 ¥	12 ¥ in 2 months
63	6 ¥	12 ¥ in 3 days	68	6 ¥	12 ¥ in 2 weeks	73	6 ¥	12 ¥ in 2 months
64	8 ¥	12 ¥ in 3 days	69	8 ¥	12 ¥ in 2 weeks	74	8 ¥	12 ¥ in 2 months
65	10 ¥	12 ¥ in 3 days	70	10 ¥	12 ¥ in 2 weeks	75	10 ¥	12 ¥ in 2 months

Table A2 Design of risk preferences experiment

	Option A		Option B	
Series 1	30% probability (Cards 1-3)	70% probability (Cards 4-10)	10% probability (Card 1)	90% probability (Cards 2-10)
1	20 ¥	5 ¥	34 ¥	2.5 ¥
2	20 ¥	5 ¥	37.5 ¥	2.5 ¥
3	20 ¥	5 ¥	41.5 ¥	2.5 ¥
4	20 ¥	5 ¥	46.5 ¥	2.5 ¥
5	20 ¥	5 ¥	53 ¥	2.5 ¥
6	20 ¥	5 ¥	62.5 ¥	2.5 ¥
7	20 ¥	5 ¥	75 ¥	2.5 ¥
8	20 ¥	5 ¥	92.5 ¥	2.5 ¥
9	20 ¥	5 ¥	110 ¥	2.5 ¥
10	20 ¥	5 ¥	150 ¥	2.5 ¥
11	20 ¥	5 ¥	200 ¥	2.5 ¥
12	20 ¥	5 ¥	300 ¥	2.5 ¥
13	20 ¥	5 ¥	500 ¥	2.5 ¥
14	20 ¥	5 ¥	850 ¥	2.5 ¥
Series 2	90% probability (Cards 1-9)	10% probability (Card 10)	70% probability (Cards 1-7)	30% probability (Cards 8-10)
15	20 ¥	15 ¥	27 ¥	2.5 ¥
16	20 ¥	15 ¥	28 ¥	2.5 ¥
17	20 ¥	15 ¥	29 ¥	2.5 ¥
18	20 ¥	15 ¥	30 ¥	2.5 ¥
19	20 ¥	15 ¥	31 ¥	2.5 ¥
20	20 ¥	15 ¥	32.5 ¥	2.5 ¥
21	20 ¥	15 ¥	34 ¥	2.5 ¥
22	20 ¥	15 ¥	36 ¥	2.5 ¥
23	20 ¥	15 ¥	38.5 ¥	2.5 ¥
24	20 ¥	15 ¥	41.5 ¥	2.5 ¥
25	20 ¥	15 ¥	45 ¥	2.5 ¥
26	20 ¥	15 ¥	50 ¥	2.5 ¥
27	20 ¥	15 ¥	55 ¥	2.5 ¥
28	20 ¥	15 ¥	65 ¥	2.5 ¥
Series 3	50% probability (Cards 1-5)	50% probability (Cards 6-10)	50% probability (Cards 1-5)	50% probability (Cards 6-10)
29	12.5 ¥	–2 ¥	15 ¥	–10.5 ¥
30	2 ¥	–2 ¥	15 ¥	–10.5 ¥
31	0.5 ¥	–2 ¥	15 ¥	–10.5 ¥
32	0.5 ¥	–2 ¥	15 ¥	–8 ¥
33	0.5 ¥	–4 ¥	15 ¥	–8 ¥
34	0.5 ¥	–4 ¥	15 ¥	–7 ¥
35	0.5 ¥	–4 ¥	15 ¥	–5.5 ¥

Appendix B. Robustness check

(1) Robustness check by using other time preferences specification

We consider another specification of discounting, in which the present bias is represented by a fixed cost rather than by a variable cost. Following Benhabib *et al.* (2010), we express the discount factor specification with fixed costs below:

$$D(y,t)=\begin{cases}1 & ,t=0\\ \exp(-rt)-\dfrac{b}{y} & t>0\end{cases} \tag{B1}$$

where the parameter *b* represents a fixed cost; the parameter *y* represents a reward in the future. In this specification, the discount factor $D(y,t)$ is not only a function of time, but also a function of the future amount (e.g., the expected consequences of contract breach). A larger fixed cost *b* is expected to be associated with a greater probability of contract breach for farmers.

We apply a maximum likelihood approach to simultaneously estimate each individual's preference parameters by incorporating both equation (2) and equation (B1) into an additive utility function. We observe that the average individual's time preference parameters *b* and *r* are 3.131 and 0.450, respectively. The average individual's risk preference parameters σ, α, and λ are 0.579, 0.749, and 2.249.

Next, we put the estimated parameters into the regression equation, and the regression results are shown in Table B1. Consistent with our expectation, we observe that both the fixed cost parameter (*b*) and the discount rate parameter (*r*) show a significant positive effect on production and sales breaches. The results imply that farmers with higher levels of impatience are more likely to breach contracts.

(2) Robustness check by excluding farmers that are not truthfully reporting

As aforementioned, that farmers might not truthfully report their contract breach behavior before the formal interview was a concern. Therefore, we identify farmers' contract breach behavior through two channels: we directly ask farmers whether they have breached contracts in the production and sales phases and set checks to identify whether farmers purchase veterinary drugs from noncorporate channels. The latter is associated with the types of preventive drugs that the farmers used. These preventive drugs are mixed with hormone drugs and other banned drugs that contracting firm does not provide. Thus, we can observe if someone has not truthfully reported a production breach. In our survey, we observed 12 farmers who claimed they did not breach contracts but were found to use banned drugs. Assuming full knowledge, these farmers can be considered as untruthful or unwilling to disclose a contract breach. There are also 51 farmers who directly reported their production breach behavior, which can be considered as a willingness to disclose a contract breach.

One concern regarding this study is that farmers' willingness to disclose is correlated with time or risk preferences and changes the interpretation of the results. For example, truthfully

reporting one's breach behavior during the survey may be considered a risk-taking action of its own because it may increase the probability of being discovered by the contracting firm. Moreover, farmers that are not truthfully reporting may pay more attention to future consequences. Therefore, we perform a robustness check by excluding the sample individuals who do not truthfully report their contract breach behavior. The regression results are shown in Table B2. We observe that the estimation results of time preference parameters are robust to excluding these untruthful farmers.

Additionally, we further explore whether farmers' willingness to disclose is correlated with time or risk preferences. We use risk and time preferences parameters as explanatory variables. The dependent variable is farmers' willingness to disclose contract breach and is indicated by a discrete value of 0 or 1. We observe that none of the time and risk preferences parameters are significant, which suggests that farmers' willingness to disclose is not correlated with time or risk preferences.

(3) Robustness check by the same/large contracting firm

As described in the data, Jiangsu province has various scales of contracting firms, and the contractual arrangements and enforcement among these firms differ. As a robustness check, we cluster standard errors by contracting firm in the regression model. The bivariate probit model is still used to estimate the parameters, and the regression results are presented in Table B3. We observe the results are very similar to those of the main regression in Table 6.

Moreover, approximately 14% of the surveyed farmers have signed contracts with small-sized firms. It is possible to suspect that farmers contracted with small-sized firms could behave differently from the remainder of the sample. Because the supervision and execution mechanisms of small-sized firms are more imperfect compared with larger-sized firms, a higher probability of contract breach may be induced. As an additional robustness check, we exclude farmers who sign contracts with small-sized firms from the sample. The regression results are presented in Table B4. We observe that the coefficients on time preference parameters remain statistically significant, which is consistent with the regression results in our whole sample.

In addition to the aforementioned robustness checks, we also use two independent probit models to estimate the effect of time preferences on the contract breach in the production and sales phases, respectively. The regression results are presented in Table B5. We observe that probit estimations give similar results.

Table B1 Robustness check by other specification

	(1)		(2)		(3)	
Variables	$breach_p$	$breach_s$	$breach_p$	$breach_s$	$breach_p$	$breach_s$
Fixed cost (*b*)	0.422***	0.279***	0.549***	0.374***	0.572***	0.378***
	(0.081)	(0.090)	(0.108)	(0.096)	(0.107)	(0.093)
Discount rate	0.457***	0.285**	0.611***	0.365**	0.604***	0.275**

(*r*)	(0.135)	(0.129)	(0.177)	(0.160)	(0.147)	(0.108)
Risk aversion			0.191*	0.182*	0.182*	0.230*
(*σ*)			(0.116)	(0.110)	(0.110)	(0.120)
Probability			–0.182	–0.179	–0.177	–0.124
weighting (*α*)			(0.113)	(0.109)	(0.111)	(0.096)
Loss			–0.270	–0.245	–0.208	–0.206
aversion (*λ*)			(0.167)	(0.153)	(0.127)	(0.127)
Other control variables					Yes	Yes
Observations		290		290		290

Notes: Explanatory variables are standardized before model regression. Robust standard errors are listed in parentheses. Asterisks: *, **, and *** denote statistical significance at 10%, 5% and 1%, respectively.

Table B2 Robustness check by excluding farmers that are not truthfully reporting

	(1)		(2)		(3)	
Variables	$breach_p$	$breach_s$	$breach_p$	$breach_s$	$breach_p$	$breach_s$
Present bias	–1.043***	–0.646***	–0.949***	–0.475***	–1.069***	–0.474***
(*β*)	(0.172)	(0.103)	(0.186)	(0.124)	(0.207)	(0.133)
Discount rate	0.445***	0.295***	0.584***	0.402***	0.730***	0.446***
(*r*)	(0.127)	(0.072)	(0.183)	(0.076)	(0.211)	(0.080)
Risk aversion			0.426***	0.466***	0.582***	0.469***
(*σ*)			(0.141)	(0.139)	(0.163)	(0.141)
Probability			–0.183	–0.140	–0.229	–0.148
weighting (*α*)			(0.124)	(0.094)	(0.140)	(0.099)
Loss			–0.130	0.042	0.026	0.050
aversion (*λ*)			(0.151)	(0.126)	(0.154)	(0.129)
Other control variables					Yes	Yes
Observations		278		278		278

Notes: Explanatory variables are standardized before model regression. Robust standard errors are listed in parentheses. Asterisks: *, **, and *** denote statistical significance at 10%, 5% and 1%, respectively.

Table B3 Robustness check by clustering standard errors at the level of contracting firm

	(1)	(2)	(3)

Variables	$breach_p$	$breach_s$	$breach_p$	$breach_s$	$breach_p$	$breach_s$
Present bias	–1.097***	–0.660***	–1.006***	–0.495***	–1.087***	–0.493***
(β)	(0.228)	(0.131)	(0.228)	(0.116)	(0.256)	(0.130)
Discount rate	0.462***	0.329***	0.622***	0.426***	0.719***	0.452***
(r)	(0.171)	(0.076)	(0.212)	(0.066)	(0.244)	(0.063)
Risk aversion			0.471***	0.411***	0.561***	0.408***
(σ)			(0.108)	(0.116)	(0.122)	(0.122)
Probability			–0.179	–0.071	–0.194	–0.070
weighting (α)			(0.160)	(0.135)	(0.154)	(0.119)
Loss			–0.148	–0.052	–0.016	–0.047
aversion (λ)			(0.095)	(0.157)	(0.110)	(0.166)
Other control variables					Yes	Yes
Observations		290		290		290

Notes: Explanatory variables are standardized before model regression. Robust standard errors are listed in parentheses. Asterisks: *, **, and *** denote statistical significance at 10%, 5% and 1%, respectively.

Table B4 Robustness check by excluding farmers from small-sized firms

	(1)		(2)		(3)	
Variables	$breach_p$	$breach_s$	$breach_p$	$breach_s$	$breach_p$	$breach_s$
Present bias	–1.081***	–0.644***	–1.010***	–0.493***	–1.067***	–0.473***
(β)	(0.169)	(0.105)	(0.191)	(0.128)	(0.198)	(0.134)
Discount rate	0.517***	0.375***	0.651***	0.451***	0.733***	0.482***
(r)	(0.156)	(0.076)	(0.218)	(0.079)	(0.232)	(0.082)
Risk aversion			0.461**	0.363***	0.555***	0.376***
(σ)			(0.153)	(0.129)	(0.162)	(0.138)
Probability			–0.219*	–0.110	–0.239*	–0.104
weighting (α)			(0.122)	(0.100)	(0.132)	(0.102)
Loss			–0.099	–0.147	–0.004	–0.123
aversion (λ)			(0.144)	(0.126)	(0.137)	(0.136)
Other control variables					Yes	Yes
Observations		250		250		250

Notes: Explanatory variables are standardized before model regression. Robust standard errors are listed in parentheses. Asterisks: *, **, and *** denote statistical significance at 10%, 5% and 1%, respectively.

Table B5 Probit model estimation results for whole sample

	(1)		(2)		(3)	
Variables	$breach_p$	$breach_s$	$breach_p$	$breach_s$	$breach_p$	$breach_s$
Present bias	–1.135***	–0.674***	–1.051***	–0.501***	–1.154**	–0.498***
(β)	(0.209)	(0.110)	(0.235)	(0.133)	(0.490)	(0.167)
Discount rate	0.458***	0.323***	0.616***	0.431***	0.715*	0.455***
(r)	(0.130)	(0.081)	(0.210)	(0.091)	(0.404)	(0.106)
Risk aversion			0.435**	0.400***	0.530*	0.395**
(σ)			(0.171)	(0.140)	(0.303)	(0.162)
Probability			–0.186	–0.069	–0.200	–0.073
weighting (α)			(0.122)	(0.107)	(0.200)	(0.123)
Loss			–0.173	–0.072	–0.050	–0.058
aversion (λ)			(0.194)	(0.149)	(0.267)	(0.167)
Other control variables					Yes	Yes
Observations	290	290	290	290	290	290

Notes: Explanatory variables are standardized before model regression. Robust standard errors are listed in parentheses. Asterisks: *, **, and *** denote statistical significance at 10%, 5% and 1%, respectively.