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1 Introduction

COVID-19 has proved to be the worst pandemic outbreak since the 1918 influenza. Besides the public health consequences, the lockdowns undertaken by various countries have led to a severe economic recession. Here, we investigate the effect of the COVID-19 crisis on individuals' risk and time preferences.

Several pathways lead to expect a decrease in risk tolerance in such situations (see Guiso et al., 2018). Individuals may expect or experience a reduction in their income or wealth. Alternatively, such a crisis may affect individuals' emotions, either making the negative outcome more salient or eliciting a fear reaction.

Similarly, regarding time preferences, one may also expect more cautious behaviors from economic agents. First, the lockdowns severely reduced consumption opportunities, thus driving an involuntary increase in savings. Second, as uncertainty about the future has increased, individuals are expected to increase their precautionary savings to buffer against future risks (Dossche and Zlatanos, 2020).

This research investigates the changes in an individual's risk and time preferences due to the COVID-19 crisis. To the best of our knowledge, it is the first study investigating such a shift in risk preferences during a natural disaster or economic crisis using a prospect theory specification that includes loss aversion.[1] It is also the first study investigating changes in time preferences at the individual level following a crisis using a longitudinal design.

Similar to the existing literature on previous economic crises, we find a decrease in risk tolerance. This decrease is attributable to an increase in loss aversion. We also find that due to a decrease in present bias, our sampled individuals become more patient for the next three to four quarters following the pandemic.

2 Literature Review

The COVID-19 pandemic shares some characteristics with natural disasters and economic crises in terms of the loss of lives and economic impact. However, the pandemic remains a unique event in contemporaneous history. The pandemic had and continues to have a worldwide effect, while natural disasters are generally more local. Furthermore, natural disasters typically entail the destruction of physical assets (e.g., houses, shops) and more severely impact individuals who own such assets. In contrast, during the pandemic, physical assets may have rather served as an instrument to insure against adverse economic effects (e.g., job loss due to the economic slowdown).

2.1 Risk Preferences

Traditionally, economics models have assumed that risk preferences are time-invariant. However, a growing stream of research has shown that individuals' risk-taking can vary in

[1] Reynaud and Aubert (2020) use a functional form of prospect theory including curvature and probability weighting, but not loss aversion.

response to shocks and life experiences (Banks et al., 2020, Guiso et al., 2018, Schildberg-Hörisch, 2018). Variation in risk-taking depends on the shock's origin. For example, negative income shocks (Dalton et al., 2020) or extreme negative events (Abatayo and Lynham, 2020) can increase the willingness to accept greater risk for larger financial rewards. In contrast, risk-taking decreases with loss of a job or a child (Hetschko and Preuss, 2020, Bucciol and Zarri, 2015), exposure to war (Bellucci et al., 2020), and health shocks (Banks et al., 2020). However, in the context of natural disasters, the results are not entirely conclusive (Chuang and Schechter, 2015). Some studies found an increase in risk-taking (Eckel et al., 2009, Page et al., 2014, Abatayo and Lynham, 2020), while others showed a decrease in risk-taking (Cameron and Shah, 2015, Cassar et al., 2017, Reynaud and Aubert, 2020). Nevertheless, it seems to be conclusive that economic crises lead to more risk aversion (Schildberg-Hörisch, 2018).

However, these studies did not measure loss aversion and attributed the change in risk tolerance to an increase in risk aversion. In our case, we take a prospect theory approach. A decrease in risk tolerance could come from an increase in risk aversion or an increase in loss aversion. Guiso et al. (2018) and Cassar et al. (2017) propose several explanatory pathways for this reduction in risk tolerance. These potential explanations include a perceived increased likelihood of future negative shocks, a change in wealth or income, or an emotion-based change in the utility or value function. Guiso et al. (2018) attribute the decrease in risk tolerance to the emotional pathway, particularly to fear.

Hypothesis 1: *The pandemic will result in a decrease in risk tolerance.*

2.2 Time preferences

Regarding time preferences, Callen (2015) and Cassar et al. (2017) explore the impact of natural disasters (tsunamis in both cases) on time discounting. Both studies use a between-subjects design, and compare unaffected and affected respondents. However, both studies did not arrive at a consensus. While Cassar et al. (2017) found more impatience after the tsunami, Callen (2015) arrived at the opposite conclusion.

Evidence about time preferences' stability is limited as few longitudinal studies have been conducted (Frederick et al., 2002). Using panel data, Krupka and Stephens Jr (2013) suggest that economic shocks, such as changes in the inflation rate and differences in household labor market outcomes, and changes in time preferences are correlated. Faced with positive (negative) savings shocks, individuals become more patient (impatient), see Dean and Sautmann (2014). In the case of COVID-19, numerous consumption opportunities, such as traveling, are unavailable, thereby leading to more savings. Such a situation could force a delay in consumption and prompt more patience in our respondents. In a sense, the pandemic is a source of a positive saving shock (Dean and Sautmann, 2014). Therefore, we hypothesize:

Hypothesis 2: *The pandemic will increase individuals' patience.*

3 Methodology

We used a within-subject design with two study waves. The first wave took place between 12 and 13 March, 2019, before the COVID-19 pandemic. The second wave took place between 4 and 25 May, 2020. At this time, various countries reached the first peak of the epidemic, and numerous others were still under various forms of lockdown. We also performed a follow-up survey to explain the changes we observed between the two waves.

Both waves and the follow-up survey were performed through Prolific Academic. This online platform is similar to MTurk but is specifically dedicated to research surveys. MTurk has been validated by Buhrmester et al. (2011), Goodman et al. (2013), and Paolacci et al. (2010) for research purposes. The respondents on Prolific Academic have the additional advantage of being more research naive (Peer et al., 2017). Respondents were paid £2 for each survey wave and £1.5 for the follow-up survey. It took them 15 minutes on average to fill each survey wave and under 5 minutes to fill the follow-up.

Both waves were identical regarding the risk and time discounting elicitation tasks. Both included measures of the amount of outstanding debt, tangible assets, and income. Besides demographic variables (age, gender, and education level), we asked questions about financial knowledge, expectation about the future, and emotion. Table I details the procedures. Examples of questions are displayed in the Appendix. The second wave also included a measure of liquidity needed within the next 6 months.

Table I: Measurement of Financial Literacy, Economic Expectation, and Emotions

Financial Literacy (1^{st} Wave)	This was measured through six questions about financial knowledge. For each question, two possible answers were provided. Participants selected an answer and stated how confident they were by giving a probability between 50% (completely unsure about the answer) and 100% (completely sure about the answer), following Pikulina et al. (2017). We considered a question correct if the respondents answer the question correctly with more than 75% confidence. We considered respondents to be financially literate if they had answered at least half of the questions correctly.
Positive Economic Expectations (2^{nd} wave)	We asked respondents whether they thought that their general economic situation would improve or deteriorate in the short term, in the long term, and whether they thought their income would increase or decrease due to the pandemic. For the analysis, we pooled these three questions (Cronbach $\alpha = 0.787$). Then, we dichotomized the obtained variable around the mean, while separating the more optimistic respondents from the others.
Emotions (2^{nd} wave)	We measured fear, disappointment, sadness, boredom, stress, anger, and happiness using 5-point Likert scales. In the regressions, we used the proportion of fear out of the total emotions expressed. Using the declared level of fear does not modify our results.

3.1 Measuring Prospect Theory Parameters

We used the method designed by Tanaka et al. (2010) to elicit prospect theory parameters. This method consists of three series of paired lotteries in the form of multiple pricing lists (MPL).

This method assumes a piece-wise power function for value and equal risk aversion, and probability-weighting parameters for gains and losses.

$$v(x) = \begin{cases} x^\alpha \text{ if } x > 0 \\ -\lambda \cdot (-x)^\alpha \text{ if } x < 0. \end{cases} \qquad \pi(p) = 1/\exp[\ln(1/p)]^\gamma$$

where α is the concavity of value function, $v(x)$, and λ is the degree of loss aversion. The value function reflects risk aversion, risk neutrality, and risk seeking when alpha is less than, equal to, and more than one, respectively. A higher degree of λ shows higher loss aversion. $\pi(p)$ is the probability weighting function with probability weighting parameter γ.

To reduce measurement error, instead of presenting lotteries in a MPL list, we showed participants one pair of choices each time. We presented the middle line in the MPL table. Then, based on participants' choice, the next line was shown. This method restricts reversal preferences and reduces respondents' confusion. The parameters of the value function can be inferred by the switching point in the selection of lotteries. Probability weighting and curvature parameters are elicited through the first two tables. The calculation of the range for the loss aversion parameters subsequently uses them as inputs alongside participants' answers in the third table. We divided all amounts by 100, compared with the initial Tanaka et al. (2010) study that used Vietnamese Dongs.

3.2 Measuring Parameters of the Time Discounting Function

We elicited participants' preference for the money-time pair in two sets of choice tasks (MPL). We used the quasi-hyperbolic discounting specification (Benhabib et al., 2010):

$$D(y;t) = \begin{cases} 1 & \text{if } t = 0 \\ \beta.exp(-rt) & \text{if } t > 0 \end{cases}$$

where y is the amount of money at t periods from now, and the two parameters r and β are time discounting and present bias, respectively. $\beta < 1$ reflects present bias: the smaller the parameter, the larger the present bias.

In the first MPL, the participants were asked to choose between an immediate smaller amount and a larger amount in 3 months. Participants could see one pair of choices each time. In the second MPL, participants chose between a smaller amount in 9 months and a larger amount in 12 months.

t = 0	t = 3 months	t = 9 months	t = 12 months
980	1000	1960	2000
900	1000	1800	2000
820	1000	1640	2000
740	1000	1480	2000
680	1000	1360	2000

To estimate the time discounting and present bias parameters, we account for the utility of outcomes, following Andersen et al. (2008). Therefore, we used the risk aversion parameter measured in the previous section to account for the utility of monetary amounts at time t. This method allowed us to elicit the respondents' time preferences while considering their risk preferences (Andersen et al., 2008). The switching point in participants' preference for the amounts in 9 and 12 months determine the time discounting parameter r. Using the estimated time discounting, we measured the present bias parameter via the switching point of choice for the amount today and in 3 months. We considered t as one quarter. Thus, r is the quarterly discounting parameter.

3.3 Sample

We collected 142 and 79 responses in the first and second waves, respectively. The final sample includes 72 participants who responded to both surveys and passed the attention question.[2] The respondents were from the Anglosphere (the UK-31%, Australia-4%, and the US-3%) and mainland European countries (mainly Italy-18%, Poland-8%, and Portugal-8%).[3]

In Table II, we show some demographic characteristics of our sample. The only significant difference is that respondents who participated in both waves tended to be slightly older than the initial total for the first wave sample. In the result section, we perform a within-subject analysis, comparing the answers to the risk and time task at T_0 (March 2019) and T_1 (May 2020) of respondents who participated in both waves.

Table II: Demographic Characteristics of the Sample

	$Wave_0$	$Wave_1$	p of $\neq$
Age	29.62	33.38	0.013**
Male	51.94%	48.61%	0.654
Employed	64.34%	68.1%	0.586
Household Income	£37 286	£35 416	0.645
Univ. Educ.	75.97%	83.33%	0.224
No Tang. Assets	37.21%	38.89%	0.814
Wedded	24.03%	29.17%	0.425
Have Child	26.36%	33.33%	0.296
No Debt	67.44%	72.22%	0.482
Anglo	42.64%	37.50%	0.477
N	129	72	

In this table, we display the descriptive statistics regarding our initial ($Wave_0$) and final samples ($Wave_1$). Note that marital status, having children, and nationality were only measured at t = 0.

[2] We performed an analysis including participants who failed to properly answer the attention question. The main results (namely, changes in loss aversion and present bias) remain the same.

[3] We have one respondent from Turkey. Excluding him does not change the result. Thus, we decided to keep this respondent in the sample and considered him to be a part of mainland Europe.

4 Results and Interpretation

4.1 Risk Preferences

On average, the coefficient of loss aversion significantly increased by 0.5, from $\lambda = 2.48$ to $\lambda = 2.98$, over our entire sample ($p < 5\%$ using Wilcoxon matched-pairs signed-rank test and $p < 10\%$ using a t-test considering the switching line, see Table IV).

This effect appears to be driven by respondents with no tangible assets, from mainland Europe, and with no children (see Figure 1).

Respondents who possessed almost no tangible assets (such as vehicles or real estate for a total value inferior to $10,000$ GBP, $n = 26$) became more loss averse, as displayed in Figure 1.1 (difference significant at $p < 5\%$, see Table IV). Their average loss aversion coefficient increased from $\lambda = 2.32$ to $\lambda = 3.87$. We argue that possessing tangible assets increases the feeling of safety, particularly in times of turmoil, thus reducing the psychological impacts of crises such as COVID-19.

This idea has been explored in the context of housing. Numerous authors posit that homeownership fosters a sentiment of "Ontological Security" more so than renting (see Hiscock et al., 2001 and Kearns et al., 2000). Ontological security refers to "The confidence that most human beings have in the continuity of their self-identity and in the constancy of their social and **material environments**" (Giddens, 1991, p.92, bold added). Part of the concept is the idea that people need "a secure base to which they can return if in trouble or fatigued" (Hiscock et al., 2001, p.50). As evidenced in Kearns et al. (2000), homeowners feel significantly safer compared to home renters.

We asked the 58 respondents (out of the 72) who answered the follow-up questionnaire the extent to which they would feel safe possessing various assets in a crisis period (see Table III). Apparently, owning any tangible assets is indeed associated with a sense of safety (T-test, $p(\neq 4) < 0.001$ in all cases). This can explain why, in a troubled period of lockdown associated with high uncertainty, respondents with almost no tangible assets and thus, not possessing a "secure base", react more strongly and become more loss averse.

Table III: The Feeling of Safety Linked to the Possession of Assets during Crises

	Likert 7 points	P - T-test $\neq 4$
House	5.862	<0.001
Car	5.569	<0.001
Tangible assets	5.655	<0.001
Stocks	3.828	0.370
n	58	

Respondents with no children ($n = 48$) were also driving the increase in loss aversion. Children have indeed been depicted as a way to reduce uncertainty. By closing off alternative life pathways, having children enforces structure in one's life (Friedman et al., 1994, Bellani et al., 2021). Similarly, it is expected that they will act as a form of insurance by increasing marital solidarity and providing care for older age.[4] Thus, the crisis might have affected respondents without children

[4]The insurance value of children is particularly true for developing countries. However, even in developed ones, children still provide significant informal care to their parents once they reach old age (Dykstra and Fokkema, 2011).

more strongly.

The increase in loss aversion was also driven by respondents from mainland Europe (increase significant at $p < 5\%$ with all methods of testing, $n = 45$). As underlined in the regressions, this effect does not appear to be linked to the number of deaths from COVID-19 (or a proxy of epidemic intensity in a country) as of 25^{th} of May 2020.[5] This could be due to the differing perception of disease gravity propounded by media and politicians amongst the countries in our sample, a hypothesis hardly testable with our data.

Nevertheless, the mainland European and Anglosphere countries in our sample clearly differed from a cultural perspective, particularly regarding uncertainty avoidance. Uncertainty avoidance is defined as "the extent to which the members of a culture feel threatened by uncertain or unknown situations", (Hofstede, 2001 p.161). The higher average uncertainty avoidance score (78 out of a 100 on average in these 15 countries against 44 for the 3 anglosphere ones) could be a possible explanation for the stronger reaction to the crisis we observe.[6]

As self-selection could be an issue in our data, we performed the Heckman selection procedure. The results regarding having fixed assets, children, and being from an Anglosphere country remain unchanged (see Table VIII).

There was virtually no change in the average probability weighting (non-significant decrease of 0.08 in the probability weighting coefficient). Risk aversion increased slightly, albeit non-significantly, as evidenced by a reduction in the risk aversion coefficient alpha.

Overall, the descriptive statistics highlight a decrease in risk tolerance driven by an increase in loss aversion, in line with hypothesis 1.

Result 1: *Within our sample, the COVID-19 pandemic resulted in a decrease in risk tolerance driven by an increase in loss aversion.*

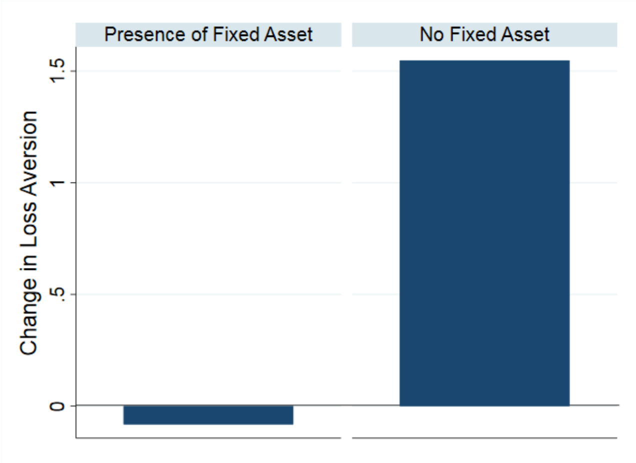
Table V displays ordinary least squares (OLS) regressions using the *change* in loss aversion as the dependent variable. Again, these regressions confirm that the increase in loss aversion observed in the overall sample is mainly attributable to participants with no tangible assets, no child, and participants from Anglosphere countries.

Result 2: *The increase in loss aversion is linked to respondents holding no tangible assets, respondents from the Anglosphere (the UK, the US, and Australia), and respondents having no children.*

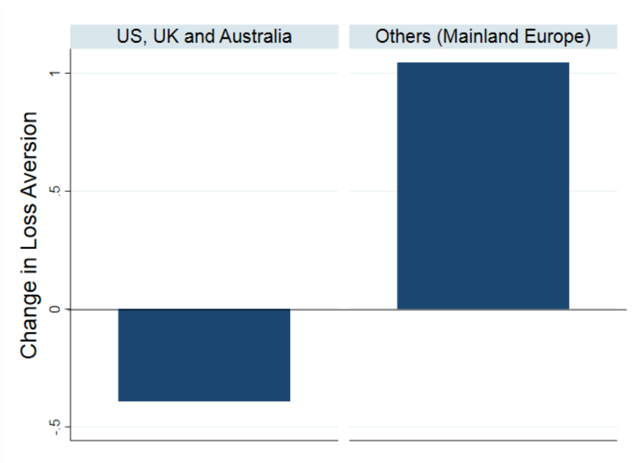
[5] Using the percentage of the population who died or the number of cases does not change the results.

[6] Note that the nature of the welfare state and social protection could also cushion the economic consequences of the crisis and be considered as an important determinant of individual willingness to take risks (see, for instance, Falk et al., 2018, Banks et al., 2020). While we cannot provide a definitive answer regarding this problem, we did not find evidence either: at purchasing power parity, OECD data from 2017 show that per capita public social spending was equivalent between the two group of countries: \$8,440 for the 15 mainland European countries and \$9,149 for the 3 Anglosphere countries.

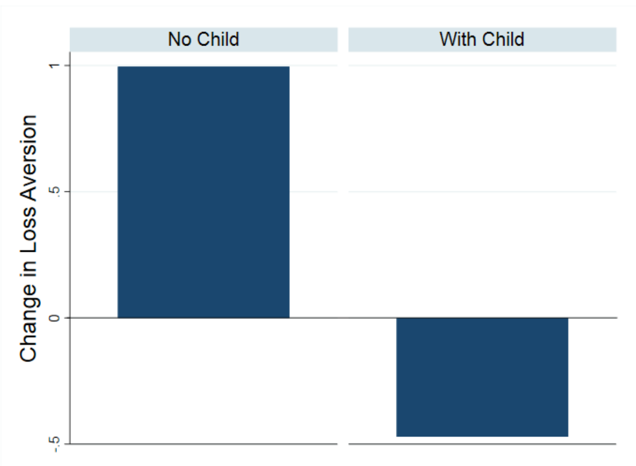
Figure 1: Change in Loss Aversion for various Respondents' Characteristics



(1.1) By Tangible Assets



(1.2) By Country



(1.3) By Parenthood

Table IV: Change in Risk Preferences between March 2019 and May 2020

	Full Sample ($n = 72$)			
	T_0	T_1	P - Wilco. Z	P - Paired T
Loss Aversion - Line	3.194	3.653	0.047**	0.073*
Loss Aversion - Coeff.	2.477	2.984	0.075*	0.129
Risk Aversion	0.624	0.589	0.555	0.285
Probability Weighing	0.915	0.907	0.785	0.788
	Respondents with no Tangible Assets ($n = 26$)			
	T_0	T_1	P - Wilco. Z	P - Paired T
Loss Aversion - Line	3.038	4.308	0.004***	0.005***
Loss Aversion - Coeff.	2.323	3.872	0.009***	0.028**
	Respondents from Mainland Europe ($n = 45$)			
	T_0	T_1	P - Wilco. Z	P - Paired T
Loss Aversion - Line	2.800	3.644	0.002***	0.002***
Loss Aversion - Coeff.	1.915	2.961	0.002***	0.002***
	Respondents with no Child ($n = 48$)			
	T_0	T_1	P - Wilco. Z	P - Paired T
Loss Aversion - Line	3.020	3.854	0.003***	0.004***
Loss Aversion - Coeff.	2.218	3.214	0.009***	0.011**

We depict the paired t-test and the Wilcoxon matched-pairs signed-rank test we performed for the whole sample regarding risk preferences. The one-sample Wilcoxon signed-rank test is an equivalent of the t-test for non-normally distributed data. It is a more appropriate statistical test for the loss aversion coefficient as the assumption of normality is rejected ($p < 5\%$, Shapiro-Wilk test). For the loss aversion coefficient, respondents who never switched have, theoretically, an unbounded loss aversion which can go up to $+\infty$. In our sample, all respondents switched at some point. Therefore, we could take the middle point of the loss aversion interval. On a side note, we observed a gender effect in our sample in both periods, with males being less loss-averse than females on average. The average coefficient of loss aversion for males was 3.01 against 1.91 for females before the crisis ($p = 5\%$, t-test). These average loss aversion coefficients increase to 3.52 for males and 2.42 for females during the crisis ($p = 5.1\%$, t-test).

Table V: Determinants of Change in Loss Aversion (LA)

	OLS Reg. (1) Change in LA Coeff.		OLS Reg. (2) Change in LA Switching line	
	Coef.	P>|t|	Coef.	P>|t|
Man	-1.121	0.146	-1.142**	0.050
Age	0.018	0.631	0.024	0.398
Fear	-0.106	0.983	-0.703	0.853
FinLit	-0.685	0.365	-0.665	0.241
Positive Econ. Expect.	0.693	0.400	0.337	0.583
Liquidity Needs	-0.015	0.958	-0.052	0.800
Income	0.206	0.229	0.187	0.145
No Debt	0.021	0.977	-0.008	0.989
No Tang. Assets	1.480*	0.056	1.149**	0.048
Wedded	1.211	0.203	0.577	0.415
Have Child	-1.858**	0.040	-1.462**	0.032
Anglo	-1.849**	0.037	-1.554**	0.020
Pop. Death	744.310	0.713	844.303	0.577
Constant	-0.013	0.995	0.252	0.874
Adj R2	0.053		0.090	
N	72		72	

In this table, we regress the change in loss aversion (both as a coefficient or as the switching line in the MPL) over several variables. There was no evidence of heteroscedasticity, non-normal residuals, or multicollinearity in any regression.

4.2 Time Preferences

We observe less present bias ($p = 5.1\%$ using the Wilcoxon test). When we split the sample around the mean of age (34 years), the effect appears to be driven by older respondents in our sample (increase in the present bias parameter β of 0.14, $p < 1\%$ for this group). The effect appears even stronger for respondents over 40 (an increase of 0.17, $p < 1\%$). We did not observe any changes regarding the time discounting parameter (r).

Result 3: *Within our sample, the COVID-19 pandemic resulted in an increase in patience, driven by a decrease in present bias.*

Figure 2 displays the resulting discounting factors ($D = \beta.exp[-rt]$) for various time horizons. Overall, we observe higher discount factors. They are significantly higher than before the pandemic for the first three to four quarters. However, the difference later becomes non-significant. We move on to OLS regressions using the change in the present bias parameter as a dependent variable. The first regression in Table VII confirms the effect of age. Because of the pandemic, older respondents are less present biased ($p < 1\%$). Respondents who have positive expectations about the future and those who do not hold any tangible assets become more present biased due to the crisis (marginally significant, $p < 10\%$). Finally, we observe an effect of the level of fear felt by participants. Participants who declare feeling higher fear levels become more present biased ($p < 1\%$). As self-selection could be an issue in our study, we run a robustness check using the Heckman procedure. The results remain essentially unchanged (see Table VIII in the Appendix).

Result 4: *Older age is linked to a reduction in present bias.*

The effect of age appears particularly intriguing, with two possible complementary explanations. First, this effect might be due to the postponement of the consumption that should have occurred during the lockdown. This postponement would then be more prevalent for the older part of the sample, as traditional physical outlets where they are accustomed to shopping were unavailable. Meanwhile, online shopping opportunities, favored on average by younger people (see for instance Lian and Yen, 2014), remained available. Second, as the lethality of COVID-19 increases sharply with age, the statistical effect of age might be due to an increased likelihood of severe health consequences.

We were able to collect data for a proxy of online purchasing behavior for 71 out of 72 respondents by pooling together data collected on some respondents by Prolific Academic and from our own follow up survey.[7] In our survey, we reproduced the question: "How often (on average) do you purchase clothing online?" We introduced this new variable in the second regression of Table VII. It proved significant ($p < 5\%$), with online shoppers displaying higher present biases during the crisis, as expected. However, it did not render age non-significant.

[7] When the answers from those sources differed, we took the average of the two.

Table VI: Change in Time Preferences Between March 2019 and May 2020

	Full Sample ($n = 72$)			
	T_0	T_1	P - Wilco. Z	P - Paired T
Present Bias	0.833	0.878	0.051*	0.107
Time Discounting	0.071	0.070	0.818	0.918
	Full Sample (n = 72) – Discount Factors			
	T_0	T_1	P - Wilco. Z	P - Paired T
Discount Factor 1Q	0.771	0.818	0.041**	0.039**
Discount Factor 2Q	0.719	0.765	0.052*	0.036**
Discount Factor 3Q	0.674	0.717	0.059*	0.052*
Discount Factor 4Q	0.635	0.675	0.106	0.079*
Discount Factor 5Q	0.600	0.638	0.174	0.113

This table depicts the paired t-test and the Wilcoxon matched-pairs signed-rank test performed over the whole sample. The Wilcoxon test is an equivalent of the t-test for non-normally distributed data. As the assumption of normality is rejected ($p < 5\%$ in all cases using the Shapiro-Wilk test, apart from the discount factors of quarter 3, where $p = 5.4\%$), it is a more appropriate test here.

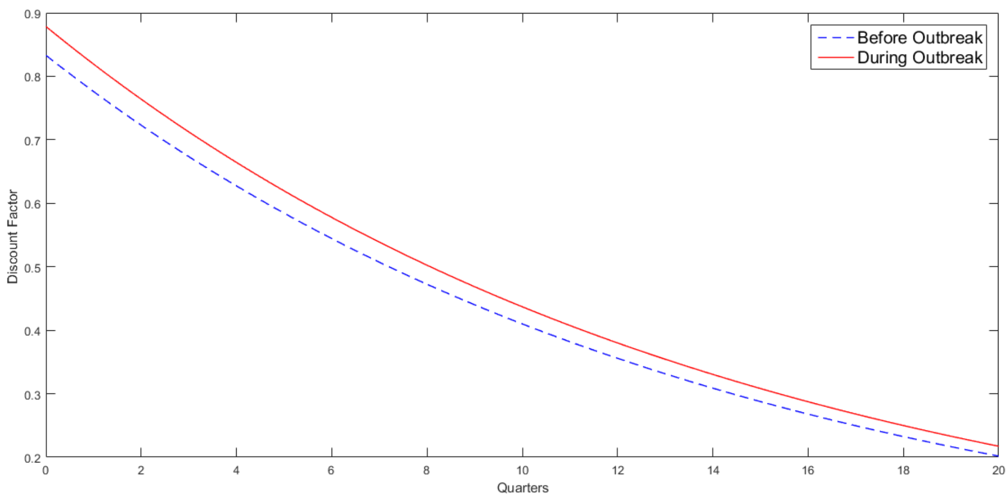


Figure 2: Discount Factors

Table VII: Determinants of Change in Present Bias

	OLS Reg. (1)		OLS Reg. (2)		OLS Reg. (3)		OLS Reg. (4)	
	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|	Coef.	P>|t|
Man	0.048	0.434	0.028	0.646	0.047	0.492	0.061	0.359
Age	0.007**	0.026	0.005*	0.082	0.006*	0.098	0.003	0.313
Fear	-1.387***	0.001	-1.172***	0.007	-1.285**	0.013	-1.565***	0.003
FinLit	-0.014	0.822	-0.022	0.713	-0.066	0.343	-0.069	0.302
Positive Econ. Expect.	-0.110*	0.097	-0.096	0.142	-0.183**	0.021	-0.162**	0.035
Liquidity Needs	-0.002	0.921	0.007	0.763	-0.003	0.913	0.006	0.787
Income	0.017	0.216	0.018	0.171	-0.002	0.918	-0.005	0.775
No Debt	0.042	0.493	0.055	0.361	0.089	0.239	0.058	0.430
No Tang. Assets	-0.103*	0.095	-0.099	0.101	-0.141**	0.049	-0.181**	0.012
Wedded	-0.050	0.511	-0.019	0.804	-0.091	0.302	-0.099	0.240
HaveChild	0.040	0.571	0.066	0.361	0.143*	0.096	0.123	0.137
Anglo	-0.024	0.728	-0.032	0.643	0.019	0.809	0.027	0.721
Pop. Death	57.399	0.722	87.643	0.579	-29.090	0.880	-99.156	0.598
Online Shopping			-0.060**	0.031	-0.058*	0.069	-0.064**	0.039
Health Consequences							0.045**	0.038
Constant	0.008	0.965	0.120	0.492	0.310	0.133	0.301	0.130
N	72		71		58		58	
Adj. R^2	0.149		0.194		0.192		0.254	

In this table, we regress the change in present bias over several variables. There was no evidence of heteroscedasticity or non-normal residuals in any regression. There was no evidence of multicollinearity. The general rule of thumb for regression requires ten observations per independent variable. Therefore, an issue might be raised, particularly regarding our last two regressions. However, the pattern of significance remains the same if we remove all control variables that are non-significant in the regressions to keep only six variables.

In the follow-up survey, we also asked, "Your health and the pandemic - If I had caught the COVID-19, the consequences for me would probably have been severe". Of 72 respondents, 58 answered this on a scale from 1 to 7. This new variable correlates with age ($\rho = 0.45$). In regression 3 of Table VII, we thus reproduce the initial regression (without this additional variable) with these 58 respondents. Again, we observe a significant effect of age, fear, having tangible assets, online shopping behavior, and expectation about the future. In regression 4, we introduce this new variable. Respondents most concerned about their health displayed less present bias ($p < 5\%$). Furthermore, the introduction of this variable renders age non-significant. Thus, the effect of age appears to be mainly explained by the possibility of severe health consequences due to the COVID.

Result 5: *The reduction in present bias linked to older age appears to be explained by the perception of more severe consequences associated with catching the COVID-19.*

5 Discussion and Conclusion

Compared to March 2019, our participants displayed higher loss aversion during the COVID-19 crisis. This increase is due to participants with the lowest amount of tangible assets and participants with no children. Based on Hiscock et al. (2001), we posit that this effect is driven by a feeling of "Ontological security", a concept encompassing the notion of confidence in the continuity of one's material existence. From the follow-up survey, it indeed appears that our participants believe that owning tangible assets in periods of crisis is associated with a sense of security. Similarly, having children brings structure into one's existence. We also find that respondents from mainland Europe are driving the increase in loss aversion. We tentatively attribute this effect to the higher cultural uncertainty avoidance of these countries compared to Anglosphere ones.

Previous studies found a decrease in risk tolerance following an economic crisis (see Schildberg-Hörisch, 2018, Guiso et al., 2018). However, they did not measure loss aversion and attributed their finding to an increase in risk aversion. Our prospect theory approach rather attributes the decrease in risk tolerance to an increase in loss aversion.

Regarding time preferences, we found that our respondents become more patient. Thus, our results support the findings of Callen (2015). The discount factors of our participants become significantly higher for the next three to four quarters. This effect is explained by the reduction in their present bias. While respondents who declared being afraid become more present biased, older respondents become less present biased during the pandemic compared to March 2019. We show that respondents who practice online shopping are more present biased during the pandemic. However, it does not explain away the effect of age. Rather, the expectation of severe health consequences if one catches COVID-19 seems to drive the decrease in the present bias of our older respondents.

Some limitations must be disclosed. First, our total sample was relatively limited ($n = 72$). However, given the repeated measure design, it was sufficient to detect rather small (as defined by Cohen, 1992) effect size (up to $d = 0.30$) with a satisfactory power ($1 - \beta = 0.8$, Cohen, 1992), and a marginal significance level α of 10% in the Wilcoxon signed-rank tests (matched pairs). Second, we only offered fixed incentives. These fixed incentives were relatively high (respondents who participated in both study waves plus the follow-up questionnaire would have earned £5.5 for approximately 30 minutes, that is £11 or $14 per hour). However, the best practice is still to offer task-specific variable incentives. Hypothetical payoffs have been shown to prompt less risk aversion (Holt and Laury, 2002). In our case, this limitation is mitigated by the fact that we are interested in the *difference* between both waves, and not the actual level.[8] Finally, due to the effect of exchange rate and standard of living, the amounts presented in the lotteries could be perceived differently in the sampled countries. Again, this issue is mitigated by the fact that we are interested in within-subject *differences* between both waves, and not the actual level.

While the COVID-19 crisis was a recent event at the time of data collection, traumatic events have the potential to durably lower stock market participation, as pointed out by Malmendier and Nagel (2011). Future research can investigate the durability of the crisis' impact on risk, time preferences, and various economic decisions.

[8] In this regard, we follow Callen (2015) who did not offer variable incentives in their study regarding the change in time preferences after a tsunami.

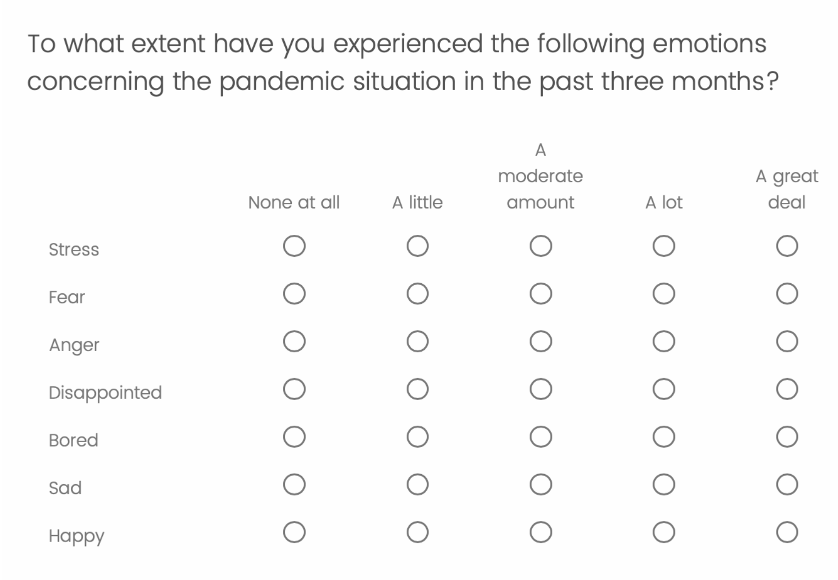
Appendix

Table VIII: Robustness Check - Heckman Two-steps Method

	Step 2 - Linear Regressions			
	Change in LA		Change in PB	
	Coef.	P. Val.	Coef.	P. Val.
Man	-1.381*	0.068	0.046	0.400
Age	0.076*	0.068	0.008**	0.033
Fear	0.435	0.925	-1.392***	0.001
FinLit	-0.536	0.415	-0.014	0.797
Positive Econ. Expect.	0.876	0.240	-0.109*	0.062
Liquidity Needs	0.095	0.699	-0.002	0.932
Income	0.208	0.168	0.017	0.164
No Debt	0.181	0.795	0.044	0.423
No Tang. Assets	1.419**	0.035	-0.102*	0.062
Wedded	1.120	0.240	-0.051	0.452
HaveChild	-1.549*	0.092	0.042	0.510
Anglo	-2.714***	0.003	-0.031	0.640
Pop. Death	726.815	0.666	60.381	0.676
Constant	-3.785*	0.090	-0.031	0.876
	Step 1 - Selection			
	Loss Aversion		Present Bias	
	Coef.	P. Val.	Coef.	P. Val.
Man	-0.038	0.880	-0.122	0.640
Age	0.073***	0.001	0.067***	0.001
Income (t0)	-0.040	0.374	-0.006	0.909
HaveChild	0.144	0.665	0.125	0.718
Wedded	-0.101	0.768	-0.073	0.836
No Tang. Assets (t0)	0.302	0.183	0.295	0.266
No Debt (t0)	0.006	0.982	0.330	0.237
Anglo	-0.457*	0.089	-0.553**	0.045
Constant	-1.731***	0.002	-1.851***	0.002
rho	0.844		0.135	
N	129		129	

This table presents the results of the Heckman procedure using the maximum likelihood estimator to control for the self-selection that might have occurred between the first and second wave. Using the two-step consistent estimate results in the same pattern of significance. The difference regarding the coefficients and significance in the selection part of the model are due to the use of the maximum likelihood estimator.

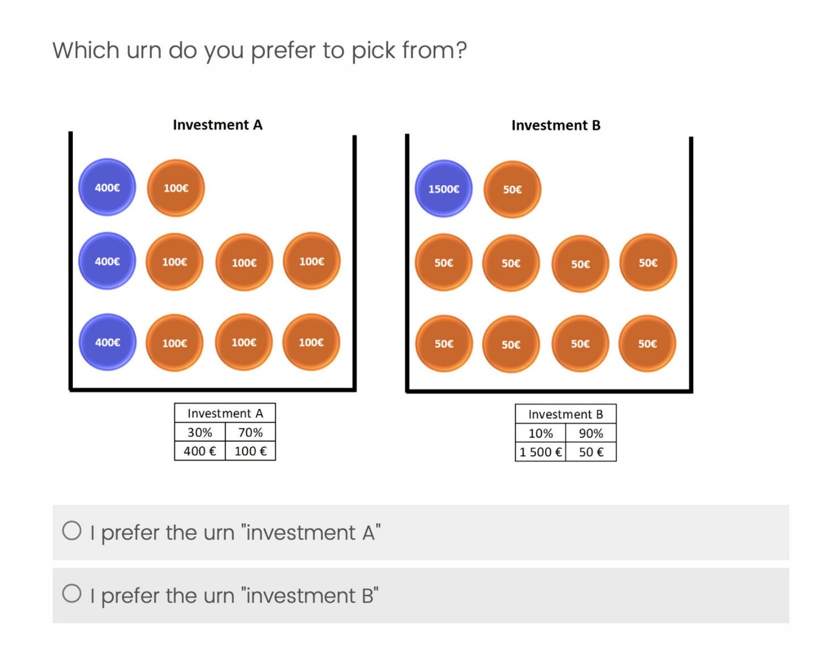
Figure 3: Questions regarding the Emotions felt by Participants


To what extent have you experienced the following emotions concerning the pandemic situation in the past three months?

	None at all	A little	A moderate amount	A lot	A great deal
Stress	○	○	○	○	○
Fear	○	○	○	○	○
Anger	○	○	○	○	○
Disappointed	○	○	○	○	○
Bored	○	○	○	○	○
Sad	○	○	○	○	○
Happy	○	○	○	○	○

Figure 4: Example of Questions about Time Preference

Figure 5: Example of Questions about Risk and Loss aversion



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