Two-part tariff, demand uncertainty and risk sharing: An experiment.*

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Abstract

In an uncertain demand environment, Rey and Tirole (1986) show that the per unit price of a two-part tariff may have insurance properties, insofar as it transfers risk from risk-averse downstream firms to upstream firms less risk averse. In this paper, we test this result in an experiment where the role of the subjects is controlled according to their elicited risk aversion. The role of the downstream firms is then held by the most risk-averse subjects. When the probability of meeting positive demand is high, the experimental results confirm the theoretical prediction: the per unit price has insurance properties such that it is higher than in a certain demand environment and the part of the rent extracted by the fixed part is lower. However, this insurance property does not stand in the experimental results when the probability of meeting positive demand is low. The results show that in such cases there is insurance demand, and that high unit prices are therefore accepted, but that this insurance demand is not satisfied enough.

Keywords: two-part tariff, vertical relationship, risk aversion, risk sharing, insurance, experiment.

JEL classification: C9, D81, L14.

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1 Introduction

Demand uncertainty is a key factor in the supply chain, especially in recession and post-recession periods. The COVID-19 crisis was no exception, and consumer demand uncertainty was a result of the pandemic that most companies had to deal with.[1] Faced with this type of phenomenon, the question of risk sharing within the supply chain arises. In a seminal paper Rey and Tirole (1986) show that, in a context of demand uncertainty, the per unit price of a two-part tariff contract may have insurance properties, in that it transfers risk from downstream firms to upstream firms. Even if a per unit price close to marginal cost is still profitable under uncertainty, the uncertainty faced by a downstream firm decreases with it. An upstream firm then has an incentive to offer a per unit price above marginal cost in order to provide insurance to a downstream firm more risk averse than it is.

This paper is the first to conduct a lab experiment to test the risk-sharing properties of two-part tariff contracts. Experimental Economics is particularly relevant here as this issue can actually be addressed in a setting of sharing a pie between individuals. We design a two-part tariff game where an upstream firm makes a take-it-or-leave-it offer to a downstream firm. The latter is assumed to be the more risk-averse of the two firms. The demand on the downstream market is so uncertain that it is positive with probability α and null with probability $(1 - \alpha)$. The game has an abstract framing with *proposers* playing as upstream firms and *responders* as downstream firms. The prediction of this game, to be tested in the lab experiment, concerns the *proposer*'s strategy in the two-part tariff contract terms, and thus its strategy in the insurance offer.

The first part of the experiment provides a lottery choice to the participants to elicit the subjects' level of risk aversion (Eckel and Grossman, 2002, Eckel and Grossman, 2008). Typically, in the experimental economics literature, risk elicitation tasks are used to control for risk attitudes ex-post. To our knowledge, we are the first to control the role of the individuals in the experiment according to their decision in the risk elicitation task. We do this to control the risk aversion level of *responders* and *proposers* such as the role of the *responders* is then held by the most risk-averse subjects. The second part of the experiment presents participants with the two-part tariff game. We adopt a between-subjects design with a perfect stranger matching procedure. We propose different treatments that match subjects according to their risk aversion levels while varying the probability of meeting positive demand.

First, we consider a high probability of meeting a positive demand ($\alpha = 0.75$). We show that the value of the per unit price is higher and the rent extraction is lower compared to the treatment with certain demand ($\alpha = 1$). These results support the theoretical prediction that the tariff has insurance properties. Finally we show that when the probability of meeting a

[1] See, e.g. the research findings of McKinskey & Company's here.

positive demand is low ($\alpha = 0.25$), the per unit price and rent extraction are not significantly different from the treatment with certain demand ($\alpha = 1$): the tariff has not insurance properties. This experimental result is explained by a behavior of the *proposers*' refusal to provide insurance through high per unit price when the probability of meeting a positive demand is low, while *responders* are willing to accept such a price.

This work contributes to the literature on risk sharing in vertical relationships. Whereas considering uncertain demand is a key factor for supply chains in the field, only few theoretical works, and to our knowledge no experimental works,[2] have considered the insurance properties of vertical contracts. Nocke and Thanassoulis (2014) analyze these properties in an environment with uncertain demand where the downstream firm is credit constrained. They demonstrate that in such an environment the downstream firm becomes risk averse and that the insurance property of vertical contract results not only from two-part tariff contracts (as showed by Rey and Tirole, 1986) but also from the fully optimal contract including demand-dependent repayments. Lømo (2020) considers the insurance properties of a two-part tariff under secret contracts, and shows that this insurance property reduces the opportunism problem and avoids marginal cost pricing. We contribute to this literature by laboratory testing the insurance property of a two-part tariff.

A take-it-or-leave-it procedure is of course a form of ultimatum bargaining. In this sense our paper contributes to the experimental literature on ultimatum bargaining, introduced by Güth *et al.* (1982). The literature on the topic is extensive (see Güth and Köcher, 2014, for a review) and focuses mainly on concerns in sharing a fixed pie (e.g. Kagel *et al.*, 1996, Fischbacher *et al.*, 2009, Cochard *et al.*, 2021). Hyndman and Walker (2022) propose a setting that involves uncertainty (subject bargain over lottery tickets instead of money) and thus consider the role of risk aversion, but still linked to equity considerations. We depart from the literature by considering two-part-tariffs, which means that in our setting the size of the pie is not fixed but endogenously determined by the "take it or leave-it" procedure. In the ultimatum bargaining literature we are moreover the first to consider two-part-tariffs as a risk-sharing instrument.

Our paper also contributes to the experimental literature of insurance demand. This topic is studied in a wide range of research fields (see Jaspersen, 2016 and Robinson and Botzen, 2019 for surveys). We depart from the literature by considering this issue of insurance demand in a setting of vertical relationships with a focus on the risk sharing properties of a two-part tariff contract. Interestingly, the originality of our experimental design is to use the results of the risk task as a treatment variable and not only as a control variable. In this sense we contribute to the methodology of measuring risk aversion in the lab (e.g. Harrison and

[2] Vertical relationships have been investigated in the experimental litterature (see Mason and Phillips, 2000; Durham, 2000, Martin *et al.*, 2001, Eguia *et al.*, 2018, Allain *et al.*, 2021 and Pasquier *et al.*, 2022), but we are the first to analyze the insurance properties of a two-part tariff in vertical relationships.

Ruthström, 2008, Crosetto and Filippin, 2016).

The paper is organized as follows. Section 2 details the experiment and section 3 presents the results of the experiment. Section 4 concludes.

2 The experiment

First, we detail the two-part tariff game considered in the experiment. We then present the experimental design, treatment variables and procedure.

2.1 The two-part tariff game

We consider a two-part tariff game where an upstream firm, denoted U produces a good with a marginal production cost $c = 0$, that it sells to one downstream firm denoted D. We assume that the contract between U and D is a two-part tariff $T \equiv (w, t)$, where w is the per unit price and t is the fixed fee. Specifically, U makes a take-it-or-leave-it offer over $T \equiv (w, t)$ in the first period. If D accepts, the game moves to the second period in which the latter sells the good to consumers. The inverse demand is given by $P(q) = \theta - q$. θ is a stochastic variable that takes the value of 1 with a probability α and the value of 0 with a probability $(1 - \alpha)$. Finally, if the offer is refused, then the gains of both firms are zero.

At the second stage when $\theta = 1$, the price is set by D at $P(w) = \frac{1+w}{2}$, and the demand is given by $q(w) = \frac{1-w}{2}$, otherwise the demand is nil. Taking w and t as given the respective profits of firms U and D at the first stage of the game are given by:

$$\begin{aligned} \pi^U &= \begin{cases} w\ q(w) + t = \frac{(1-w)w}{2} + t, & \text{if positive demand,} \\ t, & \text{if no demand,} \end{cases} \\ \pi^D &= \begin{cases} (P(w) - w)\ q(w) - t = \frac{(1-w)^2}{4} - t & \text{if positive demand,} \\ -t & \text{if no demand,} \end{cases} \end{aligned} \tag{1}$$

In the first stage, U chooses the input price w and the fixed fee t that maximize its expected utility under the constraint that D accepts this offer, i.e. under the constraint that the D's expected utility is non negative. We assume that each firm i, $(i = U, D)$, is risk averse, and, for the sake of consistency with Rey and Tirole (1986), we consider D more risk averse than U.[3] The utility $u^i(\pi^i)$, that it derives from its profit, π^i, is consistent with the properties of a von Neumann-Morgenstern utility function ($u^i(0) = 0$, $u^{i'} > 0$ and $u^{i''} < 0$). We first consider

[3]Note that Rey and Tirole (1986) consider a risk-neutral uspstream firm; however, in order to take into account the risk-averse attitudes of all individuals in our experiment, we relax this assumption considering that both firms are risk-averse, but that D is the most risk-averse. The procedure for allocating roles in the experiment according to the risk aversion of the subjects is presented in the section 2.3.2.

the case under demand certainty, i.e. for $\alpha = 1$. As it is known, with a two-part tariff U sets the marginal transfer price equal to its marginal cost, and the fixed fee equal to the rent $R = \frac{(1-w)^2}{4}$ such that the ratio of rent extraction $R_t = \frac{t}{R}$ equals 1. U is then able to realize the integrated profit. The contract terms are then such that:

$$w|_{\alpha=1} = 0, \quad t_{\alpha=1} = \frac{1}{4}, \quad \text{and} \quad R_t|_{\alpha=1} = 1. \tag{2}$$

Let us now look more specifically at the case under demand uncertainty, i.e. for $\alpha \in]0, 1[$. U maximizes its expected utility,

$$E[u^U(\pi^U)] = \alpha\, u^U\big(\frac{(1-w)w}{2} + t\big) + (1-\alpha)\, u^U(+t). \tag{3}$$

such that the fixed fee extracts all D's expected utility, i.e.

$$\begin{aligned} & E[u^D(\pi^D)] = \alpha\, u^D\big(\frac{(1-w)^2}{4} - t\big) + (1-\alpha)\, u^D(-t) = 0 \\ \Leftrightarrow \quad & u^D(t) = \alpha\, u^D\big(\frac{(1-w)^2}{4}\big) \end{aligned} \tag{4}$$

U then sets marginal transfer price superior to its marginal cost, and the fixed fee cannot extract the full amount of expected rent, $R = \alpha\frac{(1-w)^2}{4}$, through the appearance of a positive risk premium ρ (see Appendix A). The ratio of rent extraction R_t is inferior to 1, and the contract terms are such that:

$$w|_{\alpha\in]0,1[} > 0, \quad t|_{\alpha\in]0,1[} = \alpha\frac{(1-w)^2}{4} - \rho, \quad \text{and} \quad R_t|_{\alpha\in]0,1[} < 1. \tag{5}$$

As Rey and Tirole (1986) show, the uncertainty faced by D decreases with the per unit price and U then has an incentive to set it above marginal cost in order to provide insurance to D. Note that as U is also assumed to be risk averse, it also has an incentive to set the unit price at marginal cost, because the uncertainty it faces decreases with the unit price. This effect is however dominated whenever $\left|{cov\big(u^{D'},q(\cdot)\big)}/{E\big[u^{D'}\big]}\right| > \left|{cov\big(u^{U'},q(\cdot)\big)}/{E\big[u^{U'}\big]}\right|$, and this condition holds true the higher the D's level of risk aversion (see Appendix A).

The above results can be summarized by the following prediction, which will be tested in the experiment:

Prediction. *Compared to demand certainty ($\alpha = 1$), under demand uncertainty ($\alpha \in]0, 1[$) the value of a marginal transfer price w is higher and the part of extracted rent R_t is lower.*

This prediction will be tested in the experiment. It concerns the risk sharing property of a two part tariff in that : first the per unit price transfers risk bearing from a risk-averse firm D to a less risk-averse firm U (as shown by Rey and Tirole, 1986), and second the fixed fee does not extract all the rent from D. To consider the heterogeneity of firms based on their risk aversion, we will elicit the risk aversion level of the subjects and assign the role of D to those with the highest aversion levels.

2.2 Experimental design

In the experiment, the previous two-part tariff game is decontextualized and reduced to a context of sharing a gain between two participants. This gain depends on two random environments A and B. In A, the gain is split between the two participants; this environment corresponds to the positive demand case of the theoretical framework. In B, one participant's gain exactly matches the other participant's loss; this environment corresponds to the null demand case of the theoretical framework. Participants know that there is a possibility of α, and of $1-\alpha$, for environments A and B respectively to be drawn at the end of the experiment. The exact value of α is displayed at the beginning of the game.

At the beginning of the game, a role is assigned to each participant: *proposer* or *responder*. The role of *proposer* (respectively *responder*) is similar to the role of U (respectively D) in the theoretical framework. From the equation 1, we construct the rule of the gain sharing between participants such that:[4]

$$\begin{cases} \text{In } A\text{: Proposer's gain} = 100\left[\frac{(1-w)w}{2} + t\right] \text{ ; Responder's gain} = 100\left[\frac{(1-w)^2}{4} - t\right], \\ \text{In } B\text{: Proposer's gain} = 100\,t \text{ ; Responder's gain} = -100\,t. \end{cases} \tag{6}$$

The participant who has been assigned the role of *proposer* makes an offer on w and t that affects the gains of both players. The participant who has been assigned the role of *responder* (i.e. the role of D in the theoretical framework) has to accept or refuse the offer. If he refuses, both his gains and the *proposer*'s gains are nil. If he accepts both his gains and the *proposer*'s gains are determined by the *proposer*'s offer.

To make his offer, the *proposer* had to choose a value for two"instruments", instrument 1 and instrument 2 (corresponding respectively to w and to t in the theoretical framework), that both had consequences on the participants' gains. It was made clear in the instructions and with demo videos to both *proposer* and *responder* that *instrument 1* was affecting environment A *only*, whereas *instrument 2* was affecting environment A *and* environment B at the same time (see screenshots in Appendix B). To choose a value, the *proposer* could move his mouse cursor along a graduated scale centered on 0 for each instrument.[5] His offer was therefore

[4]Without loss of generality, we multiply the payoffs by 100 so that they are sufficiently salient with the experiment.

[5]For instrument 1, the gradation scale is bounded by -1 and 1, with 1 the intercept of the inverse demand $P(q)$. Although a choice of a negative w is not a Nash equilibrium, we let participants choose a negative w so as not to restrict their choice of w to potentially equilibrium values. For instrument 2, the graduation scale is

a pair of values: one value chosen on the graduated scale of instrument 1, and one value chosen on the graduated scale of instrument 2. Each time he chose a value for an instrument, the *proposer* could see on his screen the consequences of his choice on his gain, the gain of the *responder*, and the sum of both gains. All gains were represented with histograms. Thus, before validating his offer, the *proposer* was able to run simulations with values for each instrument and observing their consequences on the game's earnings. The *responder*, before accepting or refusing his partner's offer, could compare his offer with any other possible offer in the game, by running simulations with values for each instrument and observe their consequences on the game earnings.

2.3 Procedure, tasks and treatment variable

Our experiment consists of two parts. The first part of the experiment provides a lottery choice to the participants, the second part presents participants with the two-part tariff game. We adopted a between-subjects design with a perfect stranger matching procedure. This implied that: i) each participant participated in only one of the treatments and ii) none of the participants played twice with the same other participant within a single treatment. The treatment variables are the level of demand uncertainty and the level of risk aversion (as elicited by the risk task).

When participants arrived in the laboratory, they received a personal code to preserve their anonymity and were randomly assigned to a computer station. They were given an envelope containing a show-up fee of €5. The experimenter read the instructions aloud to the participants. The participants could also read the instructions by themselves since they were also projected on two screens visible to everyone. This clearly indicated that the instructions were identical for all participants. Participants were not informed that a second part would occur after the first one.

2.3.1 The lottery task

The participants first performed the lottery choice task (displayed in Appendix C), which is a version of the widely-used task designed by Eckel and Grossman (2002, 2008) that aims to measure the participants' level of risk aversion. This task - hereinafter the EG task - is a single-choice design where subjects are asked to choose one lottery from six different ones where the probabilities of low and high outcomes are always 0.5 in each lottery. Participants are then categorized into six groups according to the tottery they pick. Each group is associated with an interval of levels r of risk aversion, ranging participants from risk neutral to extremely risk averse. In an experiment, Dave *et al.* (2010) compared the behavior in an EG task to that in

bounded by $-\frac{1}{4}$ and $\frac{1}{4}$, with $\frac{1}{4}$ the total industry surplus.

Holt and Laury (2002)'s task and found that subjects considered the EG task to be simpler to understand. Our task is similar to the original EG task (Eckel and Grossman, 2002) except that we added one more lottery to get six lotteries instead of five.[6]

2.3.2 The experimental game

After the risk task, the experimenter proceeded to read the instructions of the game. We facilitated the participants' understanding of the instructions of the game in three ways. First, we designed a video demo of the computer software developed for the game for each treatment (without the real payoffs, that were displayed only when the game started). This process had the advantage of being both lively and insuring consistency in the experimenter's instructions from one session to another. Second, participants were asked to complete a questionnaire to assess their understanding of the game and the meaning of the variables, profit calculations, etc. The questionnaires were then marked by and along with the experimenter before the experiment started. Third, during the game itself, the participants had permanent access to a synthesis of its rules, by simply clicking on a button on their screen.

Once the instructions were read, the game started with real payoffs. Participants were matched into groups of one *proposer* and one *responder*. They were told that they would play the game for a certain number of *rounds*, without knowing the exact number.[7] They were also told that they would keep this role, *proposer* or *responder*, throughout all the rounds of the game, but that the computer would put them into another group for each new period. We made it clear to participants that the new *proposer* or *responder* would never be the same. At the end of each round, each participant received full feedback regarding their own decisions and those of the other participants in the same group.

The experimental task was based on the previous framework. We considered three different treatments, one with demand certainty ($\alpha = 1$, thereafter "Control") and two treatments with demand uncertainty (α=0.75,0.25, thereafter "Alpha75" and "Alpha25" treatments). As we saw in section 2.1, to test the insurance properties of the two-part tariff in the experiment, we consider the *responders* significantly more risk averse then the *proposer*. To comply with this point, we designed the following matching procedure. Before they played the game, the participants were ranked by a computer program according their risk-aversion level, from the choice of lottery 6 (corresponding to risk-neutral individuals in the EG task) to the choice

[6] The reason why we added one more lottery was twofold: first, it enabled us to increase the range of the risk aversion levels; and second, in the original EG test, the lottery 3, corresponding to medium risk-averse participants, was likely to be a focal point for the participants' choice (at it appears exactly at the middle of the lotteries presentation) and we wanted to limit this possibility. Note that Dave *et al.* (2010) also added one more lottery to the original EG task but to capture a risk seeking behavior, which is not relevant in our experiment.

[7] To compare the results between treatments, we actually planned 10 rounds of play of the game in each session.

of lottery 1 (corresponding to extremely risk-averse individuals). Those who were the least averse to risk were picked as *proposers* and those who were the most averse to risk were picked as *responders*. Following this procedure, the computer would split the participants into two subsets of players: half were *proposers* and the other half were *responders*.[8]

Once the matching procedure was over, in all treatments, before playing the game, participants were informed of their role, either *proposer* or *responder*, that they would keep this role till the end of the game, and that they would be paired with a different participant (never the same) in each new round. Then, the lottery choice of their pairing was then displayed for 30 seconds on their screen (together with their own choice) and participants played the game for a number of rounds. They knew that one round of the game would be drawn randomly at the end of the experiment (the same round for everyone) and that only this round would matter for their earnings.

When the game ended, the total payoff of the experiment was computed and displayed on each participant's screen. This payoff included a show-up fee of €5, the payoff for the game[9] and the payoff for the risk elicitation task. Participants were called one by one to a separate room and received their gains privately in cash. The average individual payoff was €14.80 while the whole experiment (including cash payments to the participants) lasted a maximum of one and a half hours.[10]

We ran 6 sessions with 20 to 26 participants each, so 148 participants in total were recruited (see Table 3 in Appendix E which presents the treatments and the number of sessions and participants per treatment). The participants were split equally across roles and treatments: there were 74 *proposers* and 74 *responders* in total. No participant came to more than one session. All of them were undergraduate students from different disciplines (e.g. mechanical science, physics, economics, political science, humanities). They were recruited through our laboratory online system. As female participants are expected to be more risk averse than male, special care was made to recruit the same proportion of male and female participants in each session. Overall proportions were 56% female and 44% male.[11] The experiment was programmed and conducted with the experimental software oTree (Chen *et al.*, 2016).

[8]Another possibility of design would be to induce risk neutral preferences for the proposers, for instance using the lottery payoff procedure proposed by Smith (1961), as considered by Roth and Schoumaker (1983) or Berg *et al.* (1986). However, in a more systematic experimental study, Walker *et al.* (1990) find very weak support for this risk-neutralizing procedure.

[9]The gains of the game were labelled in ECU, with the exchange rate of 1 ECU = €0.6 in the control treatments and 1 ECU = €0.8 in the Alpha75 and Alpha25 treatments. The reason for the different exchange rates is due to the higher probability of the participants of the Alpha75 and Alpha25 treatments suffering losses. A few subjects did suffer a loss in the Alpha25 treatment and received consequently an additional end-game fee of €5.

[10]When the game ended, participants also had to fill in a questionnaire about their strategies in the game as *proposers* or *responders*.

[11]Some participants - always males - did not show up one the day of the experiment, so we had to replace them by female participants on stand-by, which explains this bias in favor of female participants.

3 Experimental results

In this section, we report the results for each treatment. Note that the results of the risk task confirm that within each treatment, the *proposers* and *receivers'* risk aversion levels are significantly different from each other, which is consitent with our working assumption (see Appendix D).

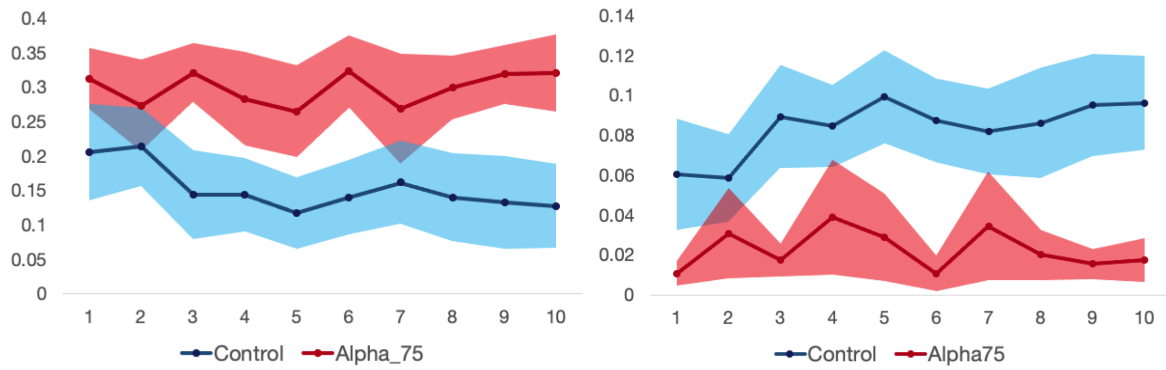
3.1 Alpha75 Treatment

In this section we focus our analysis on the Control and Alpha75 Treatment. Bear in mind that in the Control Treatment, players are certain to obtain the right outcome. In contrast, they have only a 75% chance to obtain the right outcome in the Alpha75 Treatment.

Figure 1a summarizes the results on the input price choices for the control vs. Alpha75 treatments. As expected, we find that subjects in the Alpha75 treatment choose a higher w than in the control treatment. This difference is significant in the first period of play (namely "Period 1") where each subject constitutes an independent observation (the Mann Whitney test displays $p = 0.02$ and $z = 2.39$ with 24 and 26 observations for respectively Alpha75 and Control). We then observe that subjects tend to diverge towards two different levels of w depending on the treatment they play: subjects in the control treatment seem to play a w closer to 0, whereas subjects in the Alpha75 treatment stick to playing a w far from 0.

Figure 1b summarizes the results on the fixed fee choices for the control vs. Alpha75 treatments. As expected, we find that subjects in the Alpha75 treatment choose a lower t than in the control treatment. This difference is significant in the first period of play (namely 'Period 1') where each subject constitutes an independent observation (the Mann Whitney test displays $p = 0.00$ and $z = -2.91$ with 24 and 26 observations for respectively Alpha75 and Control). We then observe that subjects tend to diverge towards two different levels of t depending on the treatment they play: subjects in the Alpha75 treatment stick to playing a t close to 0, whereas subjects in the Control treatment increasingly play a t further from 0.

We use a Structural Equation Modeling (SEM) regression with clustering of standard errors at the session level to assess the overall treatment effect. The treatment effect is encompassed by the dummy variable denoted "Alpha75", which takes the value 1 if subjects play the Alpha75 treatment and 0 otherwise. Note that we cluster the standard errors at the session level to take into account that they are correlated within sessions because the subjects interact across periods in each session. We also use Structural Equation Modeling to acknowledge the potential correlation of choices between the two (dependent) choice variables w and t. Table 1 summarizes the results. Considering the input price w, we find that, all else being equal: (i) a subject significantly decreases w along the periods in the Control treatment and (ii) significantly plays a higher w in the Alpha75 treatment compared with the Control



(a) Dynamics w (b) Dynamics t

Figure 1: Analysis of subjects' choices about (w, t)

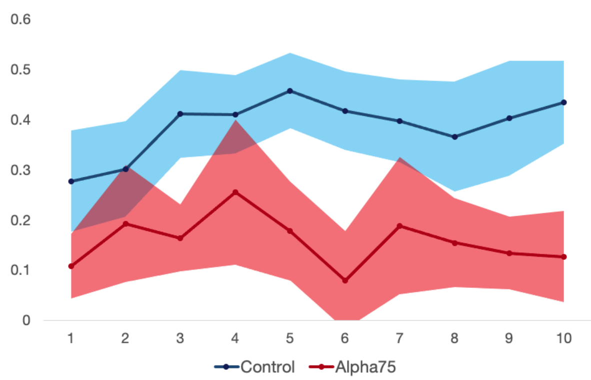
	Coef.	z
Dependent variable: w		
Period	$-.007^{***}$	-3.44
Alpha_75 × Period	.009	1.10
Alpha_75	$.095^{***}$	6.66
Cons.	$.193^{***}$	15.92
Dependent variable: t		
Period	$.003^{***}$	3.39
Alpha_75 × Period	$-.004^{*}$	-1.94
Alpha_75	$-.041^{***}$	-5.58
Cons.	$.066^{***}$	9.11
Covariance	$-.007^{***}$	-4.99
Observations	500	

Table 1: Structural Equation Modeling Regression over the contract choices (w, t) with clustering of standard errors at the session level

treatment. For the fixed fee t, we find that, all else being equal, (i) a subject significantly increases t during the periods in the Control treatment; and (ii) significantly plays a lower t in the Alpha75 treatment compared with the Control treatment.

Result 1. *The subjects quote a higher w and a lower t in the Alpha75 Treatment than in the Control Treatment.*

A significantly lower tariff t in the Alpha75 treatment than in the Control treatment may however provide a misleading information about the role of tariffs in risk sharing. Compared to the Control treatment, the Alpha75 treatment decreases the probability of the right outcome α which automatically decreases the *responder*'s expected revenues for any given level of the input price w. Thus, an observed reduction of the tariff t from Control to Alpha75 thus does not necessarily mean a reduced rent extraction resulting from the presence of the risk premium. As we saw in Section 2.1, a more suitable variable to extract the reduced rent extraction due to the risk premium effect is the ratio of rent extraction which denotes R_t^C for the Control treatment and R_t^{A75} for the Alpha75 treatment. This one is the ratio of the fixed fee choice t over the *responder*'s expected revenue $R(\alpha) = \left(\alpha\frac{(1-w)^2}{4}\right)$, given the associated input price choice w, and as expected by the theory at equilibrium $R_t^{A75} < R_t^C = 1$.



(a) Dynamics of ratios R_t^C and R_t^{A75}

	Coef.	z
Dependent variable: w		
Period	$-.007^{***}$	-3.44
Alpha_75 $\times$ Period	.009	1.10
Alpha_75	$.095^{***}$	6.66
Cons.	$.193^{***}$	15.92
Dependent variable: R_t		
Period	$.011^{***}$	6.78
Alpha_75 $\times$ Period	$-.015$	-1.14
Alpha_75	$-.149^{***}$	-39.37
Cons.	$.326^{***}$	93.55
Covariance	$-.027^{***}$	-7.17
Observations	500	

(b) SEM regression over (w, R_t) with clustering of standard errors at the session level

Figure 2: Analysis of the ratios of rent extraction

Figure 2a shows the ratios in the Control and Alpha75 treatments, and we observe that the ratio R_t^{A75} is lower than R_t^C. The decrease is significant in the first period (the Mann Whitney test displays $p = 0.02$ and $z = -2.33$ with 24 and 26 observations for respectively Alpha75 and Control). A SEM regression with clustered standard errors confirms the treatment effect of playing Alpha75 instead of Control on the ratio of rent extraction R_t (refer to the negative coefficient before the dummy variable Alpha75 in Figure 2b).

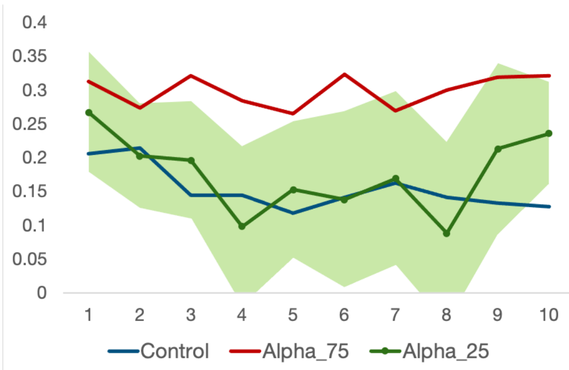
Result 2. *The ratio of rent extraction is lower in the Alpha75 Treatment than in the Control Treatment.*

The two previous results are in line with the theoretical prediction. As expected, in the presence of uncertainty, w is chosen in order to transfer risk bearing from the risk-averse *responder* to the less risk-averse *proposer*, and t is chosen to cover the *proposer*'s risk premium.

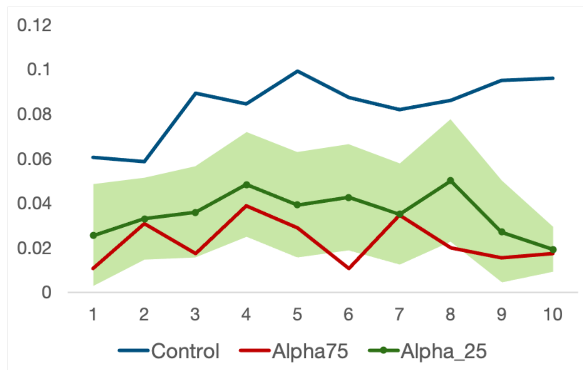
3.2 Alpha25 treatment

In this section we are interested in a variant of the experiment that we conducted to explore further patterns. It is denoted "Alpha25" and it allows us to consider an extreme case where the probability to meet a positive demand is lowered to 25%.

The theory states that we should observe the same pattern between the Control and Alpha25 treatments as we observed between the Control and Alpha75 treatments: players should increase w and decrease t. Figure 3 shows the subjects' choices.



(a) Dynamics w



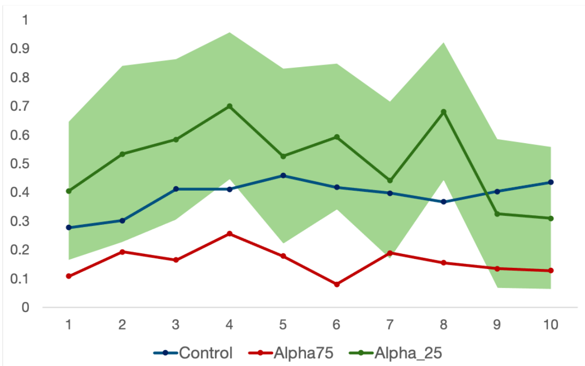
(b) Dynamics t

Figure 3: Analysis of subjects' choices regarding (w,t) according to treatments

	Coef.	z
Dependent variable: w		
Period	$-.007^{***}$	-3.44
Alpha_25 $\times$ Period	.004	1.05
Alpha_25	.001	0.02
Cons.	$.193^{***}$	15.92
Dependent variable: t		
Period	$.003^{***}$	3.39
Alpha_25 $\times$ Period	$-.004^{***}$	-3.74
Alpha_25	$-.028^{***}$	-3.76
Cons.	$.066^{***}$	9.11
Covariance	$-.010^{***}$	-4.24
Observations	500	

Table 2: SEM regression over (w, t) with clustering of standard errors at the session level

Consider the choice of w, the subjects seem to start offering an average input price at an intermediate level between that under the Alpha75 treatment and that under the Control treatment. Interestingly, the Mann Whitney tests show that the value played is weakly significantly different from that under the Control treatment while it does not differ from that under the Alpha75 treatment (the MW test between Alpha25 and Alpha75 at the first period shows $p = 0.43$ and $z = -0.784$, while the MW test between Alpha25 and Control at the first period shows $p = 0.10$ and $z = 1.614$). This result does not however hold for subsequent periods, when the subjects seem to play as they do in the Control treatment afterwards, until later periods when they start playing closer to the Alpha75 treatment again.



(a) Dynamics of ratios R_t^C, R_t^{A75} and R_t^{A25}

	Coef.	z
Dependent variable: w		
Period	$-.007^{***}$	-3.44
Alpha_25 $\times$ Period	.004	1.05
Alpha_25	.001	0.02
Cons.	$.193^{***}$	15.92
Dependent variable: R_t		
Period	$.011^{***}$	6.78
Alpha_25 $\times$ Period	$-.026^{**}$	-2.09
Alpha_25	$.267^{***}$	5.05
Cons.	$.326^{***}$	93.55
Covariance	$-.066^{***}$	-2.94
Observations	500	

(b) SEM regression over (w, R_t) with clustering of standard errors at the session level

Figure 4: Analysis of the ratios of rent extraction

Consider now the choice of t, when subjects seem to play as in the Alpha75 treatment (the MW test at the first period shows $p = 0.49$ and $z = 0.680$) and differently from the Control treatment (the MW test at the first period shows $p = 0.03$ and $z = -2.146$). Overall, the subjects thus decrease t compared with the Control Treatment. As explained above, this result can nevertheless be misleading as the *responder*'s expected revenues decrease with α. Therefore, in order to analyze the rent extraction related to t in the Alpha75 treatment, we compute the ratio $R_t^{A25} = t / \left(0.25\frac{(1-w)^2}{4}\right)$ and compare it with R_t^C and R_t^{A75}. We observe that the ratio and its associated confidence intervals overlap with the ratio in the Control treatment (see Figure 4a). A MW test confirms that at the first period the two ratios are not significantly different (the MW test shows $p = 1$ and $z = 0$). On the other hand, the ratio seems to differ from that of Alpha75 treatment. A MW test confirms this pattern (the MW test in the first period shows $p = 0.07$ and $z = 1.782$).

Result 3. *In the Alpha25 treatment, subjects play w as in the control treatment, and the rent extraction is also similar to that obtained in the control treatment.*

While it is clear that the Alpha75 treatment supports the theory that the *proposer* reduces the *responder*'s risk by increasing w and decreasing the rent extraction, this is not the case for the Alpha25 treatment. A study of the contract offers shows that in the Alpha75 treatment, only one contract offered should theoretically be refused, while in the Alpha25 treatment this number exceeds 55 contracts (see Appendix F). This result confirms that contract offers in the Alpha25 treatment are not in line with the theory. A more detailed analysis shows that there is a demand for insurance in the Alpha25 treatment, but that the *proposer* seems to be reluctant to provide it.

Remember that the contracts offered in the Alpha25 treatment are not significantly different from the ones in the Control treatment. This means that contracts offered in the Alpha25 treatment do not provide insurance to the responders. However, the *responders* reject the *proposers*'s offers more in the first period of the Alpha25 treatment than in the Control treatment (1 rejection in Control versus 6 rejections in Alpha25; the MW of rejections at the first period shows $p = 0.01$ and $z = -2.591$) and also in the subsequent periods (30 in Control versus 76 in Alpha25). These results show that *responders* reject an offer without insurance more in the Alpha25 treatment than in the Control treatment. In the Alpha25 treatment, the median of accepted input prices is higher than the median of rejected input prices (and conversely for the fixed fee). This actually shows that contracts offered in the Alpha25 treatment do not provide insurance to the *responders*. However, the *responders* look forward to receiving contracts with high input price and low fixed fee (see Appendix G).

This lack of insurance offer may be explained by an incentive problem such that the proposer may not be incited enough to offer insurance. In this case, the proposer's incentive to decrease uncertainty for himself is then higher than his incentive to decrease uncertainty for the responder.[12] Remember that as the *proposer* is risk averse, he also has an incentive to set the unit price at marginal cost, because the uncertainty he faces decreases with the unit price. This incentive problem may be strenghened by the *proposers*' reluctance to set a high unit price that consequently decreases the amount of t. Indeed, in the Alpha25 treatment, the proposer's expected payoff depends mostly on t as it has a 75% chance to be his unique gain. It means that the *proposers*'s expected payoff with insurance offer is uneven between both treatments and there may be an incentive problem.

4 Conclusion

The seminal contribution of Rey and Tirole (1986) shows that, in a context of demand uncertainty and two-part tariff, an upstream firm may offer a per unit price above marginal cost in order to provide insurance to a risk-averse downstream firm. In this work we test these insurance properties of the two-part tariff in an experiment. To do this we control the role of the subject in the experiment according to their risk-aversion level so that the *responder* (the downstream firm in the theoretical framework) has the highest risk-aversion compared to the *proposer* (the upstream firm in the theoretical framework). We show that when the probability of meeting positive demand is high, the experimental results confirm the theoret-

[12] Theoretically, this is the case when the condition described in the Lemma 1 is not respected.

ical prediction: the per unit price has insurance properties such that this price is higher than in an environment with certain demand, and the part of the rent extracted by the fixed part is lower. However, this insurance property does not stand in the experimental results when the probability of meeting positive demand is low. Our results show that the *proposers* are reluctant to offer insurance, whereas the *responders* are willing to accept an insurance offer.

5 Conflict of interest statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Allain, M.-L., Chambolle, C., Rey, P., and Teyssier, S. (2021). "Vertical integration as a source of hold-up: An experiment". *European Economic Review*, **137**:103783.

Asplund, M. (2002). "Risk-averse firms in oligopoly". *International Journal of Industrial Organization*, **20**(7):995–1012.

Berg, J. E., Daley, L. A., Dickhaut, J. W., and O'Brien, J. R. (1986). "Controlling preferences for lotteries on units of experimental exchange". *The Quarterly Journal of Economics*, **101**(2):281–306.

Chen, D. L., Schonger, M., and Wickens, C. (2016). "otree—an open-source platform for laboratory, online, and field experiments". *Journal of Behavioral and Experimental Finance*, **9**:88–97.

Cochard, F., Le Gallo, J., Georgantzis, N., and Tisserand, J.-C. (2021). "Social preferences across different populations: Meta-analyses on the ultimatum game and dictator game". *Journal of Behavioral and Experimental Economics*, **90**:101613.

Crosetto, P. and Filippin, A. (2016). "A theoretical and experimental appraisal of four risk elicitation methods". *Experimental Economics*, **19**(3):613–641.

Dave, C., Eckel, C. C., Johnson, C. A., and Rojas, C. (2010). "Eliciting risk preferences: When is simple better?" *Journal of Risk and Uncertainty*, **41**(3):219–243.

Durham, Y. (2000). "An experimental examination of double marginalization and vertical relationships". *Journal of Economic Behavior and Organization*, **42**(2):207–229.

Eckel, C. C. and Grossman, P. J. (2002). "Sex differences and statistical stereotyping in attitudes toward financial risk". *Evolution and Human Behavior*, **23**(4):281–295.

Eckel, C. C. and Grossman, P. J. (2008). "Forecasting risk attitudes: An experimental study using actual and forecast gamble choices". *Journal of Economic Behavior and Organization*, **68**(1):1–17.

Eguia, J. X., Llorente-Saguer, A., Morton, R., and Nicolò, A. (2018). "Equilibrium Selection in Sequential Games with Imperfect Information". *Games and Economic Behavior*, **109**:465–483.

Fischbacher, U., Fong, C. M., and Fehr, E. (2009). “Fairness, errors and the power of competition”. *Journal of Economic Behavior and Organization*, **72**(1):527–545.

Güth, W. and Köcher, M. (2014). “More than thirty years of ultimatum bargaining experiments: Motives, variations, and a survey of the recent literature”. *Journal of Economic Behavior and Organization*, **108**(C):396–409.

Güth, W., Schmittberger, R. W., and Schwarze, B. (1982). “An experimental analysis of ultimatum bargaining”. *Journal of Economic Behavior and Organization*, **3**:367–388.

Harrison, G. W. and Ruthström, E. (2008). *Risk Aversion in the Laboratory*, volume 12, pages 41–196. Emerald Group Publishing Limited.

Holt, C. and Laury, S. (2002). “Risk aversion and incentive effect”. *American Economic Review*, **92**(5):1144–1655.

Hyndman, K. and Walker, M. J. (2022). “Fairness and risk in ultimatum bargaining”. *Games and Economic Behavior*, **132**:90–105.

Jaspersen, J. G. (2016). “Hypothetical surveys and experimental studies of insurance demand: A review”. *Journal of Risk and Insurance*, **83**(1):217–255.

Kagel, J., Kim, C., and Moser, D. (1996). “Fairness in ultimatum games with asymmetric information and asymmetric payoffs”. *Games and Economic Behavior*, **13**(1):100–110.

Lømo, T. L. (2020). “Vertical control, opportunism, and risk sharing”. *Economics Letters*, **191**:109114.

Martin, S., Normann, H.-T., and Snyder, C. M. (2001). “Vertical Foreclosure in Experimental Markets”. *The RAND Journal of Economics*, **32**(3):466–496.

Mason, C. and Phillips, O. R. (2000). “Vertical integration and collusive incentives: an experimental analysis”. *International Journal of Industrial Organization*, **18**(3):471–496.

Nocke, V. and Thanassoulis, J. (2014). “Vertical relations under credit constraints”. *Journal of the European Economic Association*, **12**(2):337–367.

Pasquier, N., Bonroy, O., and Garapin, A. (2022). “Risk aversion and equilibrium selection in a vertical contracting setting: an experiment”. *Theory and Decision*, **93**(4):585–614.

Rey, P. and Tirole, J. (1986). “The logic of vertical restraints”. *The American Economic Review*, **76**(5):921–939.

Robinson, P. J. and Botzen, W. J. W. (2019). “Economic experiments, hypothetical surveys and market data studies of insurance demand against low-probability high impact risks: A systematic review”. *Journal of Economic Surveys*, **33**(5):1493–1530.

Roth, A. E. and Schoumaker, F. (1983). “Expectations and reputations in bargaining: An experimental study”. *The American Economic Review*, **73**(3):362–372.

Smith, C. A. B. (1961). “Consistency in statistical inference and decision”. *Journal of the Royal Statistical Society. Series B (Methodological)*, **23**(1):1–37.

Walker, J. M., Smith, V. L., and Cox, J. C. (1990). “Inducing risk-neutral preferences: An examination in a controlled market environment”. *Journal of Risk and Uncertainty*, **3**(1):5–24.

Appendices

A Equilibrium condition to have insurance property

The U maximization problem is given by the maximization, with respect to w and t, of the following Lagrangian function[13] $\mathcal{L}^U(w,t,\lambda) = E\Big[u^U(\pi^U) - \lambda\big[u^D(\pi^D)\big]\Big]$, yielding the following set of first-order conditions:[14]

$$\begin{cases} \frac{\partial \mathcal{L}(\cdot)}{\partial w} = E\big[u^{U'}(q(\cdot) + w\frac{dq(\cdot)}{dw}) - \lambda[u^{D'}(-q(\cdot) + \frac{\partial \pi}{\partial q}\frac{dq(\cdot)}{dw})]\big] = 0, \\ \frac{\partial \mathcal{L}(\cdot)}{\partial t} = E[u^{U'} - \lambda\big[-u^{D'}]\big] = 0, \\ \frac{\partial \mathcal{L}(\cdot)}{\partial \lambda} = E\big[-u^D\big(\pi^D\big)\big] = 0. \end{cases} \tag{7}$$

The last condition of the system (7) implies that when D is risk averse the optimal fixed fee t^* respects the following $E\big[u^D\big(P(\cdot)q(\cdot) - wq(\cdot) + t\big)\big] = u^D\big(E\big[P(\cdot)q(\cdot) - wq(\cdot) + t\big] - \rho\big) = 0$ with ρ a positive risk premium. We obtain:

$$t^* = E\big[P(\cdot)q(\cdot) - wq(\cdot)\big] - \rho < E\big[P(\cdot)q(\cdot) - wq(\cdot)\big]. \tag{8}$$

The two first conditions of the system (7) define the optimal price w. Using the envelope theorem we rewrite these two conditions

$$\begin{cases} E\big[u^{U'}(q(\cdot) + w\frac{dq(\cdot)}{dw}) - \lambda[u^{D'}(-q(\cdot))]\big] = 0, \\ \lambda = -\frac{E\left[u^{U'}\right]}{E\left[u^{D'}\right]}, \end{cases} \tag{9}$$

which we combine together to determine a specific condition on the marginal transfer price at equilibrium $w^* = \left[\frac{E\left[u^{D'}q(\cdot)\right]}{E\left[u^{D'}\right]} - \frac{E\left[u^{U'}q(\cdot)\right]}{E\left[u^{U'}\right]}\right]\frac{E\left[u^{U'}\right]}{E\left[u^{U'}\frac{dq(\cdot)}{dw}\right]}$, that we may rewrite:

$$w^* = \left[\frac{cov\big(u^{D'}, q(\cdot)\big)}{E\big[u^{D'}\big]} - \frac{cov\big(u^{U'}, q(\cdot)\big)}{E\big[u^{U'}\big]}\right]\frac{E\big[u^{U'}\big]}{E\big[u^{U'}\frac{dq(\cdot)}{dw}\big]} \tag{10}$$

The following Lemma analyzes when both firms are risk averse the condition such as the marginal transfer price w of the two-part tariff is positive, i.e. has insurance properties:

Lemma 1. *When D and U are risk averse then w^* is set at a positive level provided that* $\left|cov\big(u^{D'}, q(\cdot)\big)/E\big[u^{D'}\big]\right| > \left|cov\big(u^{U'}, q(\cdot)\big)/E\big[u^{U'}\big]\right|$.

[13] With π^U and π^U given by equation (1), and λ the Lagrange multiplier associated to the constraint that D accepts the offer.

[14] With $u^{i'} = \frac{\partial u^i(\pi^i)}{\partial \pi^i}$ for $i = (U, D)$; $q(.) = \frac{1-w}{2}$ for θ=1 and $q(.) = 0$ for θ=0.

Proof. Under the properties of the von Neumann-Morgenstern utility function we have $u^{i'} > 0$ such as $E\left[u^{i'}\right]$ is positive. Moreover as the pass through $\frac{dq(\cdot)}{dw}$ is negative, $E\left[u^{U'}\frac{dq(\cdot)}{dw}\right]$ is also negative. Therefore the sign of $\frac{E\left[u^{U'}\right]}{E\left[u^{U'}\frac{dq(\cdot)}{dw}\right]}$ is negative, and w^* is positive if and only if $\left[\frac{cov\left(u^{D'},q(\cdot)\right)}{E\left[u^{D'}\right]} - \frac{cov\left(u^{U'},q(\cdot)\right)}{E\left[u^{U'}\right]}\right] < 0$. Remember that here θ is a stochastic variable, such as it is equal to 1 with a probability α and nul with a probability $(1-\alpha)$. In this way when θ increases then q and π^i increases and thereby $u^{i'}$ is reduced (because $u^{i''} < 0$): $cov\left(u^{i'}, q(\cdot)\right)$ is then negative, with $i = \{D, U\}$. Therefore, w^* is positive provided that: $\left|cov\left(u^{D'},q(\cdot)\right)/E\left[u^{D'}\right]\right| > \left|cov\left(u^{U'},q(\cdot)\right)/E\left[u^{U'}\right]\right|$. $\square$

As shown by Rey and Tirole (1986), the uncertainty faced by a downstream firm decreases with the per unit price and U then has an incentive to set it above marginal cost in order to provide insurance to D. However, when U is risk averse, it also has an incentive to set the unit price at marginal cost, because the uncertainty it faces decreases with the unit price. Therefore the insurance property of the per unit price is ambiguous when both firms U and D are risk averse and depend from the relation between $\left|cov\left(u^{D'},q(\cdot)\right)/E\left[u^{D'}\right]\right|$ and $\left|cov\left(u^{U'},q(\cdot)\right)/E\left[u^{U'}\right]\right|$. Nevertheless, as $\left|cov\left(u^{D'},q(\cdot)\right)/E\left[u^{D'}\right]\right|$ increases with the concavity of u^D (see Asplund, 2002 and Lømo, 2020), the condition $\left|cov\left(u^{D'},q(\cdot)\right)/E\left[u^{D'}\right]\right| > \left|cov\left(u^{U'},q(\cdot)\right)/E\left[u^{U'}\right]\right|$, such that the unit price is positive and has insurance properties, is respected the more risk averse D is.

B Screenshots of the oTree interface of the game

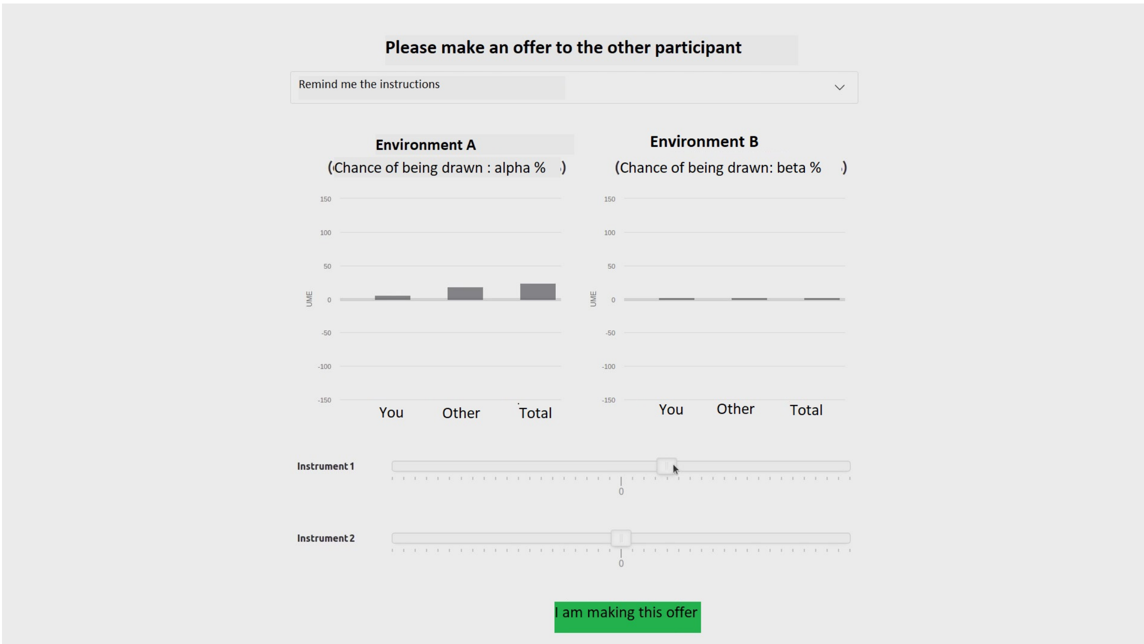


Figure 5: Screenshot of the *proposer* (adapted from the original in French)

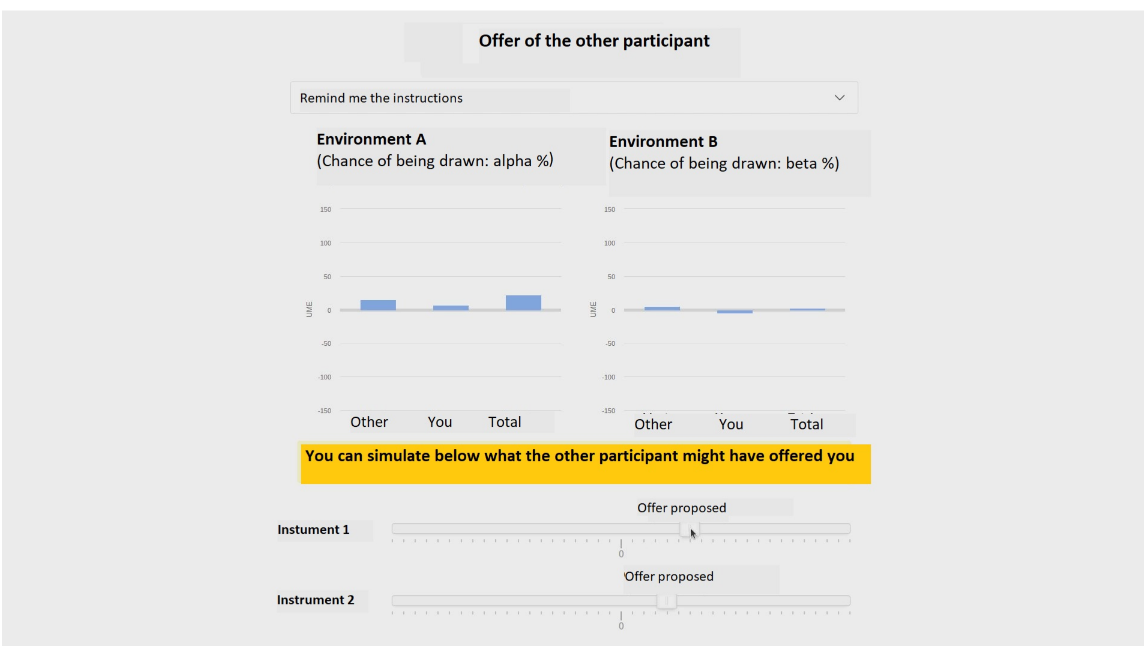


Figure 6: Screenshot of the *responder* (adapted from the original in French)

C Risk elicitation task

Number	Probabilities	Gains
1	50 %	4 €
	50 %	4 €
2	50 %	5 €
	50 %	3.5 €
3	50 %	6 €
	50 %	3 €
4	50 %	8 €
	50 %	2 €
5	50 %	10 €
	50 %	1 €
6	50 %	12 €
	50 %	0 €

(a) The ordered lottery selection (Eckel & Grossman's method)

Preference	Risk aversion	Level of r
Lottery 1	Stay in bed	$r \geq 3.94$
Lottery 2	Extremely risk averse	$3.94 > r \geq 1.32$
Lottery 3	High risk averse	$1.32 > r \geq 0.67$
Lottery 4	Middle risk averse	$0.67 > r \geq 0.38$
Lottery 5	Low risk averse	$0.38 > r \geq 0.20$
Lottery 6	Risk neutral	$0.20 > r \geq 0$

(b) Categorization of risk aversion

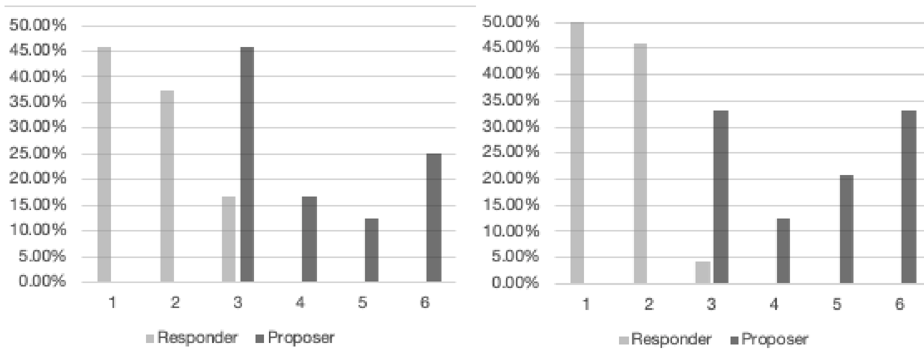
Figure 7: The risk elicitation task

Table 7a provides an overview of our risk elicitation task. We depart from the original EG test (Eckel and Grossman, 2002) by adding one more lottery (Lottery 2). This test is a simple single-choice design where subjects are asked to choose one gamble from six different gambles where the probabilities of low and high outcomes are always 0.5 in each gamble. In an experiment, Dave *et al.* (2010) compared the behaviors in this task to those in the Holt and Laury (2002)'s task and found that subjects considered the former task to be more simple to understand. The EG task provided more reliable estimates of risk aversion for subjects with limited mathematical ability.

Table 7b displays associated examples of levels of risk aversion assuming subjects hold a Constant Relative Risk Aversion utility function. Formally, the example assumes each subject holds the utility function $u(x_k) = \frac{x^{1-r}}{1-r}$ if $r \neq 1$ and $ln(x)$ otherwise where $r \in \Re$ denotes the subject's level of risk aversion, and x denotes the lottery k's outcome. A subject who picked Lottery $k \in [\![1, 6]\!]$ is equivalent to $Eu(x_k) > Eu(x_j)$ with $j \neq k$ and where $Eu(.)$ denotes the expected utility of the subject. The inequality holds for certain values of r which are displayed in the table below for each lottery.

D Results on risk aversion

This appendix section categorizes the subjects with respect to their lottery choices at the lottery task.



(a) A75

(b) A25

Figure 8: Difference of lottery choices for each couple of proposer-responder at Period 1

Figure 8 displays the distributions of the subject's lottery choices by role for each treatment with demand uncertainty (i.e. A75 and A25). We find significant difference between the subjects' choices for each treatment with demand uncertainty. This supports our assumption that responders are more risk averse than proposers. The Mann Whitney tests display a p-value of 0.00 for A75 and also 0.00 for A25.

E Experiments

Dates	Treatment	Nb of Sessions	Nb of subjects	Nb of observations (w, t)
Nov. 18, 2021	Alpha25	1	24	120
Apr. 27, 2022	Alpha25	1	24	120
Nov. 18, 2021	Control	1	26	130
Nov. 19, 2021	Control	1	26	130
Nov. 22, 2021	Alpha75	1	24	120
Nov. 23, 2021	Alpha75	1	24	120
	Total	6	148	740

Table 3: Experimental treatments, number of sessions, subjects and observations

For the empirical analyses, we consider contract offers (w, t) for each *proposer* observed over 10 rounds (thus in total we get 74*10 = 740 observations).

F Comparison of receivers' empirical and theoretical choices

Appendix F compares the receivers' empirical choices with the theoretical choices receivers should have made given their elicited level of risk aversion. Let us remind that the elicited levels of risk aversion actually provide intervals of levels of risk aversion. Each result in the present table is thus an array where the first component is the result with the bottom bound of the intervals of risk aversion, and the second component is the result with the top bound of these intervals. Moreover, to compute the theoretical choices, we assume that the maximum level of risk aversion is $r = 6$ and we insert the subjects' show-up fee into their payoffs to avoid computing power of negative payoffs. The result constitutes the joint distribution of the empirical and theoretical choices. For example, the number 36 (respectively 21) in table 4 means that 36 (respectively 21) contracts were rejected (respectively accepted) while they should be rejected given the bottom bounds of the subjects' levels of risk aversion (see Appendix F). Consequently, in the Alpha75 treatment, if we consider all the contract offers, only one contract should be rejected theoretically, whereas in Alpha25 treatment, this number exceeds 55 contracts.

		Theoretical choice	
		Reject	Accept
Empirical choice	Reject	[36, 38]	[40, 38]
	Accept	[21, 24]	[143, 140]
240 observations			

Table 4: Alpha25 Treatment

		Theoretical choice	
		Reject	Accept
Empirical choice	Reject	[1, 1]	[39, 39]
	Accept	[0, 0]	[200, 200]
240 observations			

Table 5: Alpha75 Treatment

G Accepted and rejected offers in Alpha25

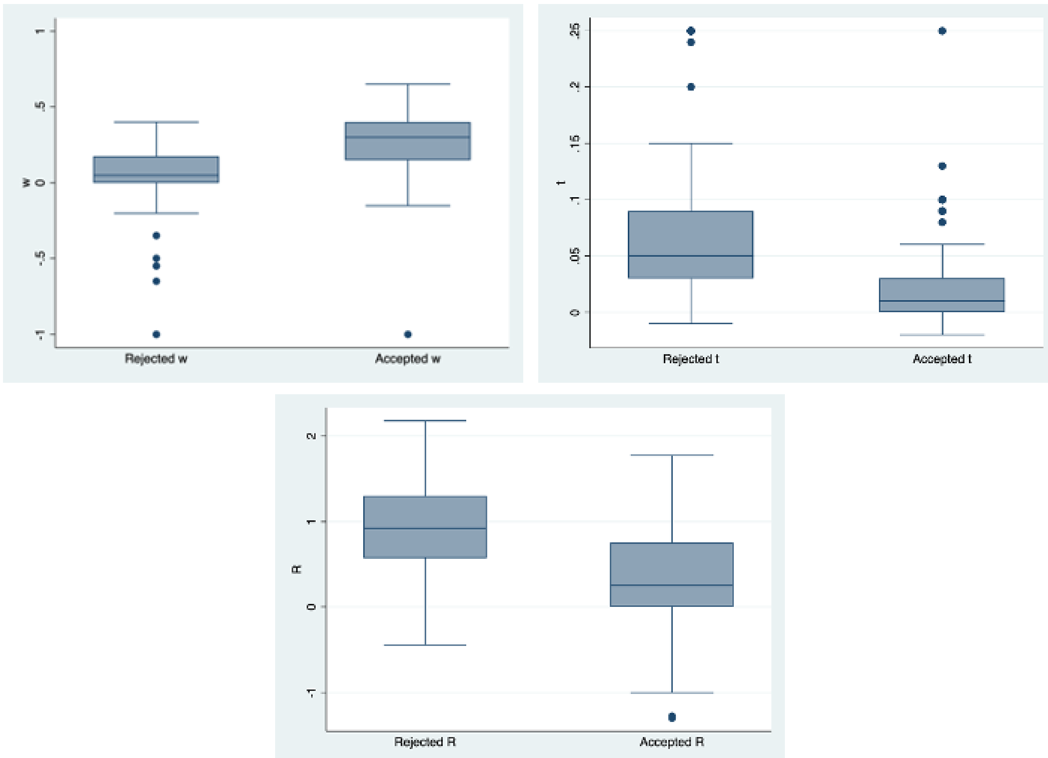


Figure 9: Accepted vs. Rejected offers