Risk aversion and equilibrium selection in a vertical contracting setting: An experiment*

Nicolas PASQUIER[†1,2], Olivier BONROY[‡1], and Alexis GARAPIN[§1]

[1]Université Grenoble Alpes, INRAE, UMR GAEL, 38000 Grenoble, France
[2]Department of Economics/NIPE, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal

January 12, 2022

Abstract

The theoretical literature on vertical relationships usually assumes that beliefs about secret contracts take specific forms. In a recent paper, Eguia *et al.* (2018) propose a new selection criterion that does not impose any restriction on beliefs. In this article, we extend their criterion by generalizing it to risk-averse retailers, and we show that risk aversion modifies the size of the belief subsets that support each equilibrium. We conduct an experiment which revisits that of Eguia *et al.* (2018). We design a new treatment effect on equilibrium selection depending on the retailers' risk sensitivity. Experimental results confirm the treatment effect: the more sensitivity there is towards risk, the more the equilibrium played is consistent with passive beliefs. In addition, extending Eguia *et al.* (2018)'s criterion to risk-averse retailers improves its predictive power on the equilibria played, especially for a population of retailers with moderate to extreme risk aversion.

Keywords: Secret contract, risk aversion, beliefs elicitation, experiment.
JEL classification: L14, C90

*The authors gratefully acknowledge the financial support of the University Grenoble Alpes. They are particularly grateful to Aniol Llorente Saguer for invaluable discussions and also thank Eric Avenel, Emanuele Bacchiega, Anna Bayona, Paolo Crosetto, Ani Guerdjikova, Guillaume Hollard, Emmanuel Petrakis, Thibaud Vergé, as well as JIE 2018, EARIE 2018 and ASSET 2018's participants for their very useful comments. The usual disclaimer applies.

† ✉ nicolas.pasquier@univ-grenoble-alpes.fr
‡ Corresponding author ✉ olivier.bonroy@inrae.fr
§ ✉ alexis.garapin@univ-grenoble-alpes.fr

1 Introduction

A key issue for every analysis of vertical relationship frameworks with secret contracts is how retailers react to "unexpected" (i.e. out of equilibrium) offers. Their reaction to such offers depends on their beliefs about the contracts offered to their rivals. The theoretical literature usually assumes that their beliefs may take three forms: passive, symmetric, or wary (see McAfee and Schwartz, 1994), and finds that the equilibrium outcomes are very sensitive to the assumptions made about beliefs.[1] Rey and Tirole, 2007 show for instance that where passive beliefs support a Cournot outcome, symmetric beliefs may support monopoly outcome. Recently, Eguia *et al.* (2018) proposed a criterion, the Largest Set of Beliefs (hereafter LSB), avoiding restricting the set of beliefs. The selected equilibrium is then the one supported by the largest set of beliefs. By avoiding imposing a specific form of beliefs, such a criterion opens the door to an analysis of the effect of retailers' risk aversion on the set of beliefs that support the equilibria, and hence on the equilibrium selection. Few studies have considered the role of risk aversion of retailers in vertical relationships with secret contracts, because this raises the problem of the correlation between beliefs and risk aversion. Yet it is well established that retailers can behave as if they were risk averse,[2] and that this behavior is not neutral in vertical relationships. In their seminal article, Rey and Tirole (1986) establish that retailers' risk aversion modifies manufacturers' strategies, the latter having to provide insurance to retailers. Thus, if contracts are public, the need to share risk hinders the manufacturer's ability to exploit its market share. What about secret contracts? To our knowledge, only Lømo (2020) considers simultaneously a secret contract framework and risk-averse retailers, and shows that retailers' risk aversion may mitigate the well-known opportunism problem of secret contracts. In his work, the author assumes passive beliefs. But are these beliefs plausible for risk-averse retailers? What is the link between the retailers's risk sensitivity and the beliefs that support the equilibrium? Our

[1] The beliefs that are the most frequently used in the literature are passive beliefs and symmetric beliefs. Under passive beliefs, when a retailer receives an out-of-equilibrium offer, it does not revise its beliefs about the offers made to others. Conversely, under symmetric beliefs, when a retailer receives an out-of-equilibrium offer, it believes that all the others receive the same offer as it receives. Wary beliefs are based on the fact that each retailer thinks that others receive offers that are the supplier's optimal choices, given the offer it makes to that retailer. Such beliefs receive less attention in the literature. Note that Avenel (2012) considers another form of belief: the "full capacity beliefs" that are consistent with an upstream capacity constraint.

[2] This is especially true for retailers with liquidity constraints, credit constraints or a limited number of customers (see Asplund, 2002, Banal-Estañol and Ottaviani, 2006, Nocke and Thanassoulis, 2014).

work attempts to answer these questions by extending the LSB criterion to risk-averse retailers.

In this paper, we consider a vertical contracting game with secret contracts, adapted from Rey and Tirole, 2007, and characterize the effect of players' level of risk aversion on the equilibrium selection. Specifically, we consider a risk-neutral supplier making secret offers to two risk-averse retailers. This game has two equilibria in pure strategy: one supported by symmetric beliefs and characterized by a *high-price offer* and the *monopoly outcome*, and one supported by passive beliefs and characterized by a *low-price offer* and the *Cournot outcome*.[3] These equilibria are standard in the literature on secret contracting (see e.g. Rey and Tirole, 2007). We then select the equilibrium by generalizing the LSB criterion so that it takes into consideration the retailers' risk aversion.

Our paper revisits the Eguia *et al.* (2018) experiment by considering the effects of the risk-aversion retailers on the sets of beliefs that support the "*high-price offer* equilibrium" or the "*low-price offer* equilibrium", and on the equilibrium selection. To do this we use the initial endowment as a treatment variable. The variation of this endowment (that can be either high or low) captures the "risk sensitivity" of risk averse retailers. Compared to the treatment with a high endowment, the retailer's risk sensitivity is stronger in the treatment with a low endowment.

Overall, our experiment confirms our treatment effect. We find that: (i) when the retailers are risk averse, participants play more low-price-offer equilibrium in the treatment with a low initial endowment than in the treatment with a high initial endowment, (ii) by extending the LSB criterion to risk-averse retailers, we improve its predictive power on the equilibria played out, particularly for a population of moderately to extremely risk-averse retailers. Our results stress that in environments where the retailers' risk sensitivity is strong, the equilibrium supported with passive beliefs seem more plausible than the equilibrium supported with symmetric beliefs.

Our research contributes to the experimental literature on vertical contracting. Much of this literature investigates the effect of vertical mergers in different vertical industry structures (see Mason and Phillips, 2000, Durham, 2000 and Martin *et al.*, 2001). Other contributions have focused on communication in vertical contracting (see e.g. Moellers *et al.*, 2017). Like Eguia *et al.* (2018), Martin *et al.* (2001) suggest that assuming specific out-of-equilibrium beliefs does not enable one

[3] As in Rey and Tirole (2007), wary beliefs support the same equilibrium than passive beliefs.

to capture the complexity of strategies in vertical relationships. In an experiment on vertical contracting games, Martin *et al.* (2001) provide evidence that assuming homogeneous beliefs may be inappropriate. Our contribution to this literature is twofold. First, we analyze the relation between the retailers' risk sensitivity and the set of beliefs that support the equilibrium. We show that the greater the sensitivity towards risk, the more the equilibrium played will be consistent with the set of beliefs that includes the passive beliefs. Second, we use incentivized methods during the game to elicit subjects' beliefs. We show that elicited passive beliefs do not explain the treatment effect predicted theoretically and observed in the experiment. Our results on elicited beliefs highlight the limitations of the ad hoc specification of beliefs (whether passive or symmetric) as a good predictor of the equilibrium played.

Our paper contributes also to the literature that investigates, in the lab, wealth effects on the curvature of the utility function, using variations of payoffs in experimental tasks to test their effect on risk aversion (Harrison and Rutstrom, 2008; Harrison *et al.*, 2017). Our contribution to this literature is to consider that variations of initial endowment can modify the locations of the payoff values of the (retailers') utility function. This variation makes them more or less sensitive to a same level of risk aversion and impacts the set of beliefs that supports the selection of one equilibrium.[4]

The paper is organized as follows. Section 2 introduces the theoretical framework extending the Eguia *et al.* (2018) contracting game to risk-averse retailers. Section 3 details the experimental design. Section 4 presents the results of the experiment, and Section 5 concludes.

2 A vertical contracting game with risk-averse retailers

2.1 Framework

In line with the Eguia *et al.* (2018) experiment, we consider a simplified framework of vertical relationships where a supplier makes secret offers to two retailers, based on the model by Rey and

[4] In a different setting, an asset market experiment, Ackert *et al.* (2006) also study the effect of a rise in the level of cash endowment and show that it changes traders' decisions, predictions and incidentally the final outcomes. Yet, Ackert *et al.* (2006) connect their work to the literature that investigates "house money" effects in the lab, first evidenced by Thaler and Johnson (1990) in a setting based on prospect theory (see e.g. Clark, 2002, Davis *et al.*, 2010, Jing and Cheo, 2013). We depart from this literature as in our experiment the variation of the retailers' initial endowment is not consecutive to a "windfall gain".

Tirole (2007). However, in contrast to Eguia *et al.* (2018) we consider risk-averse retailers. The timing of the game is as follows: (1: offers) the supplier secretly and simultaneously offers a price $p_i \in \{p^H = 36, p^L = 15\}$ to each retailer $i \in \{1,2\}$ for each unit bilaterally delivered; (2: orders and profits) each retailer i decides the quantity q_i to buy from the supplier, with $q_i \in \{0,1,2,3\}$; the retailers then release the goods in the final market where the inverse demand is given by: [5]

$$(P(1), P(2), P(3), P(4), P(5), P(6)) = (103, 100, 46, 45, 28, 18). \tag{1}$$

The retailer's profits are given by:

$$\pi_i(q_i, q_{-i}, p_i) = \begin{cases} e - c + P(q_i + q_{-i})q_i - p_i q_i, & \text{if } q_i > 0 \\ e, & \text{otherwise.} \end{cases} \tag{2}$$

We assume a contract cost $c = 33$ and an initial endowment e.[6] We assume that both retailers have the same level of initial endowment. The endowment captures the "risk sensitivity" of retailers. Increasing initial endowment then changes the location of all the payoff values on the retailers' utility function. Indeed, payoffs values with a higher initial endowment are located on a flatter part of the utility function, making risk averse retailers locally less risk sensitive (see Pratt, 1964).

The supplier earns profits given by:

$$\pi_0(q_i, q_{-i}, p_i, p_{-i}) = q_i p_i, + q_{-i} p_{-i}. \tag{3}$$

We further assume, as Eguia *et al.* (2018) do, that the supplier is risk neutral. However, in contrast to Eguia *et al.* (2018), we consider that retailers are risk averse.[7] Formally, while Eguia *et al.* (2018) assume that retailers hold linear utility functions, we instead consider that they hold concave utility functions. More precisely, we consider that retailers have preferences following the

[5] Our assumptions on p^H, p^L and the inverse demands, and the retailer's profit allow for an opportunistic incentive for the supplier and lead to the existence of the two equilibria highlighted in Rey and Tirole (2007). See Eguia *et al.* (2018) for a microfondation of these assumptions.

[6] We focus on e values for which the retailer's profits are positive for all values of q_i considered.

[7] This asymmetric assumption is well established in the literature on vertical relationships (see e.g. Rey and Tirole, 1986 and Ma *et al.*, 2012).

Constant Relative Risk Aversion utility function (CRRA):

$$u(\pi) = \begin{cases} \frac{\pi^{(1-r)}}{1-r}, & \text{if } r \in [0,1[\cup]1,+\infty[\\ \ln(\pi), & \text{otherwise} \end{cases} \tag{4}$$

where π is the payoff of the retailer of interest. The higher r is, the more risk-averse the retailer will be. And the reverse is true. Note that for $r = 0$ the retailer is risk neutral. This family of utility functions has been widely used in the experimental literature since Holt and Laury (2002) because it often offers a good fit to data (Harrison and Rutstrom, 2008).[8] The utility function also has the useful property that higher payoffs lie on a flatter part of the utility function which means that the retailers are less sensitive to risk for higher payoffs (the absolute risk aversion decreases Pratt, 1964).

2.2 Equilibria and associated belief sets

We focus on the symmetric equilibria in pure strategies of the above game. Lemma 1 presents these equilibria:

Lemma 1. *There are two symmetric equilibria in pure strategies:*

- *In one equilibrium, denoted L, the supplier offers $p^L = 15$ to both retailers and each retailer buys 2 units if the price offered is p^L and 0 units if the price is p^H. The equilibrium profits of supplier and retailers are respectively $\pi_o^L = 60$ and $\pi_i^L = e + 27$.*
- *In the other equilibrium, denoted H, the supplier offers $p^H = 36$ to both retailers and each retailer buys 1 unit if the price is p^H and 2 units if the price is p^L. The equilibrium profits of supplier and retailers are respectively $\pi_o^H = 72$ and $\pi_i^H = e + 31$.*

Proof. See Appendix A. □

These equilibria are the standard equilibria discussed by the literature on secret contracting. The low-price-offer equilibrium, equilibrium L, corresponds to a situation where the two downstream firms release the Cournot quantities, and the high-price-offer equilibrium, equilibrium H,

[8] Refer to Wakker (2008) and Moffatt (2015) for a detailed discussion of other utility functions.

corresponds to a situation where the two downstream firms release the Monopoly quantity (see Rey and Tirole, 2007). Each of these equilibria is supported by a belief set that we detail below.

Note that the sustainability of each equilibrium depends on the retailers' reactions following an unexpected, or equivalently an out-of-equilibrium, price offer. Upon such offer, a retailer must infer the suppliers' action towards the other retailer in order to set its strategy. Each retailer's out-of-equilibrium strategy thus actually critically depends on their out-of-equilibrium beliefs upon out-of-equilibrium offers. For clarification, let $w(p^H_{-i}|\bar{p}_i) \in [0,1]$ be the belief of retailer i that its rival (retailer $-i$) gets the high price p^H when it (retailer i) is offered an out-of-equilibrium price $\bar{p}$. Due to additivity, once $w(p^H_{-i}|\bar{p}_i)$ is set we easily get $w(p^L_{-i}|\bar{p}_i)$.

Consider equilibrium L, this equilibrium is supported by beliefs such that, after observing the out-of-equilibrium price $\bar{p}_i = p^H$, retailer i buys 0 units, $q_i = 0$, rather than 1, 2 or 3 units. This occurs as long as upon receiving out-of-equilibrium price p^H, retailer i thinks that its is sufficiently unlikely that its rival gets price p^H. In other words, the retailer i's out-of-equilibrium belief, $w(p^H_{-i}|\bar{p}_i)$, has to lie below a certain threshold that we denote w_L. The following lemma more formally presents this idea through the concept of the subset of out-of-equilibrium beliefs supporting equilibrium L:

Lemma 2. *There exists a subset of retailer i's out-of-equilibrium beliefs, denoted by* $\Delta_L = \{w(p^H_{-i}|\bar{p}_i) \in [0,1] \;\; | \; w(p^H_{-i}|\bar{p}_i) \in [0, w_L]\}$, *which supports equilibrium* L. *The parameter* w_L *bounds this set and is such that* $w_L = \min\{w_{L_{1/0}} \equiv \frac{u(e)-u(e-23)}{u(e+34)-u(e-23)},\; w_{L_{2/0}} \equiv \frac{u(e)-u(e-15)}{u(e+95)-u(e-15)},\; w_{L_{3/0}} \equiv \frac{u(e)-u(e-57)}{u(e-3)-u(e-57)}\}$. *The beliefs outside* Δ_L *induce that after observing the out-of-equilibrium price* $\bar{p}_i = p^H$, *retailer* i *deviates from* $q_i = 0$ *and Equilibrium* L *is not sustainable.*

Proof. See Appendix B. □

It is important to note that the *passive beliefs* restriction, widely used in the literature about secret contracting, supports equilibrium L. With *passive beliefs* a retailer that receives an out-of-equilibrium offer does not update its beliefs about the offer retailer gets, so that the belief sticks to the equilibrium offer (McAfee and Schwartz, 1994). In equilibrium L, a retailer expects that both itself and its rival will get the equilibrium offer p^L. Upon out-of-equilibrium offer $\bar{p}_i = p^H$, this retailer continues to believe that the other retailer receives p^L. This implies $w(p^H_{-i}|\bar{p}_i = p^H) = 0$. The *passive beliefs* are de facto in the subset of retailer i's beliefs Δ_L that supports equilibrium L. This finding is summarized in the following corollary of Lemma 2.

Corollary 1. *In equilibrium L, the passive beliefs imply $w(p^H_{-i}|\bar{p}_i = p^H) = 0$, and therefore belong to the sub-set Δ_L and support equilibrium L.*

Similarly, equilibrium H is supported by beliefs such that, after observing the out-of-equilibrium price $\bar{p}_i = p^L$, retailer i chooses to buy 2 units, $q_i = 2$, and not 0, 1 or 3 units. This happens when, upon receiving the out-of-equilibrium price $\bar{p}_i = p^L$, retailer i thinks that it is sufficiently unlikely the rival gets price p^H. In other words, retailer i's out-of-equilibrium belief, $w(p^H_{-i}|\bar{p}_i)$, has to lie below a certain threshold that we denote w_H. Lemma 3 more formally defines the subset of out-of-equilibrium beliefs supporting equilibrium H:

Lemma 3. *There exists a subset of retailer i's out-of-equilibrium beliefs, denoted by $\Delta_H = \{w(p^H_{-i}|\bar{p}_i) \in [0,1] \mid w(p^H_{-i}|\bar{p}_i) \in [0, w_H]\}$, which supports equilibrium H. The parameter w_H bounds this set and is such that $w_H = \min\{w_{H_{0/2}} \equiv \frac{u(e+27)-u(e)}{u(e+27)-u(e+29)}, w_{H_{1/2}} \equiv \frac{u(e+27)-u(e-2)}{u(e+52)-u(e-2)+u(e+27)-u(e+29)}, w_{H_{3/2}} \equiv \frac{u(e+27)-u(e+6)}{u(e+57)-u(e+6)+u(e+27)-u(e+29)}\}$. The beliefs outside Δ_H imply that after observing the out-of-equilibrium price $\bar{p}_i = p^L$, retailer i deviates from $q_i = 2$ and Equilibrium H is not sustainable.*

Proof. See Appendix C. □

Once more, it is worth noting that the *symmetric beliefs* restriction, sometimes used in the literature about secret contracting, supports equilibrium H. With *symmetric beliefs* a retailer that receives an out-of-equilibrium offer thinks that the other retailer gets the exact same offer (McAfee and Schwartz, 1994). In equilibrium H a retailer expects that both itself and its rival will get price p^H. Upon receiving out-of-equilibrium $\bar{p}_i = p^L$, this retailer thinks the other retailer also gets p^L. This implies that $w(p^H_{-i}|\bar{p}_i = p^L) = 0$. The *symmetric beliefs* thus belong to the subset of retailer i's beliefs Δ_H that supports equilibrium H. This finding is summarized in the following corollary of Lemma 3.

Corollary 2. *In equilibrium H the symmetric beliefs imply $w(p^H_{-i}|\bar{p_i} = p^L) = 0$; they therefore belong to the subset Δ_H and support equilibrium H.*

Note that subset Δ_H is unlikely to include *passive beliefs* and, conversely, subset Δ_L is unlikely to include *symmetric beliefs*. Consider equilibrium H: *passive beliefs* imply $w(p^H_{-i}|\bar{p_i} = p^L) = 1$, which is superior to w_H as soon as $w_H < 1$. For equilibrium L, *symmetric beliefs* imply $w(p^H_{-i}|\bar{p_i} = p^H) = 1$, which is superior to w_L as soon as $w_L < 1$. Both *passive* and *symmetric beliefs* are thus extreme beliefs in our framework, and they each support a particular equilibrium.

2.3 The equilibrium selection

Which equilibrium is more reliable? Eguia *et al.* (2018) argue that the equilibrium most likely to be played is the one sustained by the largest set of beliefs. According to this criterion, the focal equilibrium of our game is thus equilibrium L (respectively equilibrium H) whenever the size of Δ_L is larger (respectively smaller) than the size of of Δ_H. Or, equivalently, when $w_L > w_H$, the equilibrium in which the supplier proposes $p^L = 15$ to both retailers, is a better prediction, whereas when $w_H > w_L$, the equilibrium in which the supplier proposes $p^H = 36$ to both retailers, is a better prediction.

Compared with Eguia *et al.* (2018), our belief sets account for the retailers' level of risk aversion. Therefore, according to the LSB criterion, the equilibrium most likely to be played depends on the retailers' level of risk aversion. In addition, we observe that belief sets depend on the initial endowment, providing risk aversion is strictly positive (see Lemma 2 and 3). We thus argue that the focal equilibrium depends on both the retailers' level of risk aversion r and on the initial endowment e, provided that risk aversion is strictly positive. When retailers' risk aversion is nil, i.e. $r = 0$, retailers are risk neutral and the focal equilibrium does not depend on e, which is the case in Eguia *et al.* (2018) framework. Consequently, in our framework and in contrast to Eguia *et al.* (2018), varying e modifies the size of the belief sets, provided that retailers are strictly risk averse, which may impact the equilibrium played.

As mentioned previously, a rise in the initial endowment makes risk-averse retailers locally less sensitive to risk. We control the retailers' local sensitivity to risk aversion through the variation in their endowment, and we analyse the effect on equilibrium selection. The next section investigates this issue.

3 Experimental design

In this section, we propose an experiment based on the previous framework, to assess the strength of this effect on the profile of the equilibrium actions, the participants' strategies, and the participants' beliefs. This section describes the experimental procedure, tasks and treatment variable, then derives the behavioral predictions.

3.1 Procedure, tasks and treatment variable

Our experiment divides into two parts. The first and main part presents participants with a vertical game (based on Section 2). We adopted a between-subjects design with two treatments. It implies that each participant participated in only one of the two treatments. The treatment variable is the retailers' level of initial endowment. Note that only the first part of the experiment varies from one treatment to another. The second part of the experiment provides a lottery choice to the participants. The subsections below details the procedure and tasks of each part.

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 then given an envelope containing a show-up fee of 5 €. Each session had 12 participants.

3.1.1 The vertical game.

The experimenter first read the instructions aloud to the participants. The participants could also read the instructions by themselves since they were also projected on a common screen. This clearly indicated that the instructions were identical for all the participants. At the end of the instructions, participants answered a questionnaire to check their understanding. After the questionnaire, participants played with a simulator of payoffs (see Appendix D) for about 5 minutes. Only then, the experimental game with real payoffs started. Besides, to make the participants fully aware of the other participants' payoffs and facilitate their understanding of the game, they had permanent access to the simulator on the left-hand side of their screen.

Participants were randomly matched into groups of one supplier and two retailers. Participants were told that they would play the experimental game 25 periods. They were also told that they would keep their role of either supplier or retailer throughout these 25 periods, but that the computer would randomly re-match them into another group at each new period. At the end of each period, they received full feedback regarding the other participants' decisions in the same group.

The experimental framework of vertical relationships is based on the previous section. We consider two distinct treatments: one with a high initial endowment $e = 69$, hereinafter named *treatment HE*, and one with a low initial endowment $e = 28$, hereinafter named *treatment LE*. Compared to the first treatment, risk aversion plays a greater role in the second treatment as explained in section 2.

In both treatments, we ask the supplier to secretly offer p^H or p^L to each retailer. In the meantime, we ask each retailer to secretly choose a quantity *for each* supplier's possible offer. More precisely, the retailers decide on both a quantity which is either 0 or 1 unit in case the supplier offers p^H, *and* a quantity which is either 0, 2 or 3 units in case the supplier offers p^L. We thus follow Eguia *et al.* (2018) in the experiment by restricting the quantities that the retailers can choose following a supplier's offer. This is to facilitate both the participants' choice[9], and the analysis[10]. Remind that all payoffs are available in a simulator when the participants make their decisions.

In addition, and simultaneously to the quantity choice, the retailers are asked to reveal their beliefs about their rival's offer. In other words, we ask them to guess the offer the supplier would make to the rival for each possible move. We ask these two specific questions: "Imagine the supplier offers you a high price, what price do you think it will offer to the other retailer?" and "Imagine

[9] The objective of the restriction is to minimize the set of retailers' strategies. First, we keep the rejection strategies ("0 quantity"). Second, we keep the equilibrium strategies ("0 quantity" following p^H and "2 quantities" following p^L at Eq. L, "1 quantity" following p^H and "2 quantities" following p^L at Eq. H). Third, we keep the optimal deviations if beliefs are not sufficiently robust ("3 quantities" upon receiving unexpected price p^L at Eq. H, "1 quantity" upon receiving unexpected price p^H at Eq. L). Therefore, upon obtaining p^H, a retailer can choose between 0 and 1 whereas, upon receiving p^L, a retailer can choose between 0, 2 and 3.

[10] In addition, as we will see in the following, by restraining the strategy set, the thresholds w_L and w_H are respectively given by $w_{L_{1/0}}$ and $w_{H_{3/2}}$. Thereby, we avoid for instance, that in one treatment, w_L is given by $w_{L_{1/0}}$, while in the other treatment w_L is given by $w_{L_{2/0}}$ or $w_{L_{3/0}}$. The same is true for for w_H.

the supplier offers you a low price, what price do you think it will offer to the other retailer?" (see Appendix E for a discussion of issues on incentivized methods of eliciting beliefs).

Treatment HE

		Quantity bought by the other retailer			
		0	1	2	3
Quantity bought by retailer i	0	69	69	69	69
	1	103	100	46	45
	2	206	98	96	62
	3	129	126	75	45

Treatment LE

		Quantity bought by the other retailer			
		0	1	2	3
Quantity bought by retailer i	0	28	28	28	28
	1	62	59	5	4
	2	165	57	55	21
	3	88	85	34	4

Both treatments

		Quantity bought by the retailer			
		0	1	2	3
Price set by the supplier	p^H	0	36	/	/
	p^L	0	/	30	45

Table 1: Players' payoff matrices

The participants make all their choices by observing the payoff matrix of each player (retailer and supplier), summarized for both treatments in Table 1. All payoffs are in ECU. When all the participants have made their choices, the computer matches their decisions and displays their realized pay-offs. Note that if a retailer's belief matches the supplier's play, then this retailer is rewarded additionally 40 ECU. Participants play this vertical contracting game for 25 periods. However, they are only rewarded the payoff of a random period.

When the game ended, the participants were asked to perform the risk elicitation task (the lottery choice task). They had not been aware that this risk elicitation would occur, though they were aware that there would be several parts to the experiment.

3.1.2 The lottery task.

The lottery choice task (displayed in Appendix F) 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. In an experiment, Dave *et al.* (2010) compared the behavior in EG task to that in Holt and Laury (2002)'s task and found that subjects considered EG task to be simpler to understand. The EG task provides more reliable estimates of risk aversion for subjects with limited mathematical ability.[11]

At the end of the experiment, only one period of the vertical contracting game was used for the payment of the first part of the experiment. The total amount of ECU earned in the experiment was converted into euros at the following conversion rate: 1 ECU = 0.05 €. In total, subjects earned on average 20.43 €. This amount includes a show-up fee of 5 €, the payoff for the game, the payoff for the risk elicitation task, and finally an end-game fee of 9.5 € (in LE) or 7.75 € (in HE). Our treatment variable lies in the payoff of the game. To give another view of its weight in the game, note that its value amounts to 3.45 € in treatment HE and 1.4 € in treatment LE. It then respectively represents 64.5% of retailers' average earnings in HE and 34% of retailers' average earnings in LE.[12]

We ran 18 sessions with 12 participants each, so 216 participants in total were recruited. The participants were split equally across roles and treatments: there were 36 suppliers and 72 retailers in each treatment. No participant came to more than one session. All of them were students from different disciplines (e.g. Mechanics, Physics, Economics) with minimum undergraduate mathematical skills but no prior knowledge of game theory. They were recruited through our laboratory online system. The experiment was programmed and conducted with the experimental software z-Tree (Fischbacher, 2007).

[11]Note that performing the risk test after accumulating earnings in the 2-stage game might theoretically impact subjects' choices in the risk test. However, subjects are not aware of their earnings from the first part before performing the lottery task. In addition, it is very unlikely that they are able to compute the expected payoff they get from the first task since only 1 period out of 25 is randomly drawn for payment. Actually, it is very unlikely that they remember all their potential payoffs.

[12]More precisely, the subjects' average earnings details as follows in euros across roles and treatments. *Suppliers*: Show-up fee: 5; Game: 2.85 (HE) 2.9 (LE); Risk test: 3.25 (HE) 2.3 (LE); End-game fee: 7.75 (HE) 9.5 (LE); *Retailers*: Show-up fee: 5; Game: 5.35 (HE) 4.1 (LE); Risk test: 2.5 (HE) 2.9 (LE); End-game fee: 7.75 (HE) 9.5 (LE).

3.2 Predictions

As each retailer must secretly choose a quantity for each supplier's possible offer, we obtain the following thresholds w_L and w_H for both treatments:

$$w_L = \frac{u(e) - u(e-23)}{u(e+34) - u(e-23)} \ , \ \text{ and } \ w_H = \frac{u(e+27) - u(e+6)}{u(e+57) - u(e+6) + u(e+27) - u(e+29)} \tag{5}$$

Note that $w_L = w_{L_{1/0}}$ because it is the only feasible threshold (see Lemma 2). Also, we have $w_H = w_{H_{3/2}}$ because for all parameter values considered we have $w_{H_{3/2}} < w_{H_{0/2}}$ and the remaining threshold is not feasible (see Lemma 3).

Figure 1 presents for both treatments HE and LE the differences between the two thresholds w_L and w_H with respect to the level of risk aversion. The level of risk aversion is on the x-axis while the difference between the two thresholds, henceforth the value $w_L - w_H$, is on the y-axis. The value $w_L - w_H$ represents the size difference between both subsets of beliefs Δ_L and Δ_H such that: i) when $w_L - w_H > 0$ then Δ_L is larger than Δ_H and equilibrium L is a better prediction than equilibrium H; and ii) when $w_L - w_H < 0$ then Δ_L is lower than Δ_H and equilibrium H is a better prediction than equilibrium L. In addition, the higher $|w_L - w_H|$, the greater the difference between the two subsets of beliefs Δ_L and Δ_H.

Consider risk-neutral retailers. We have $w_L = 0,403$ and $w_H = 0,428$ and, as in Eguia *et al.* (2018), the thresholds do not depend on the level of initial endowment e. In both treatments HE and LE, the difference between the thresholds is negative, $w_L - w_H = -0,025$. Equilibrium H is then theoretically a better prediction than equilibrium L, whenever $r = 0$. The following prediction summarizes this outcome.

Prediction 1. *According to the LSB criterion built under the risk-neutral retailers assumption, equilibrium H is a better prediction than equilibrium L in both treatments.*

For risk averse retailers, we observe three areas in Figure 1. For all $r \in]0, 0.17[$, w_L is lower than w_H irrespective of the treatment and equilibrium H is thus theoretically a better prediction than equilibrium L for both treatments. For all $r \in [0.17, 0.78[$, w_L is lower than threshold w_H in treatment HE but is higher in treatment LE. Equilibrium H remains a better prediction than

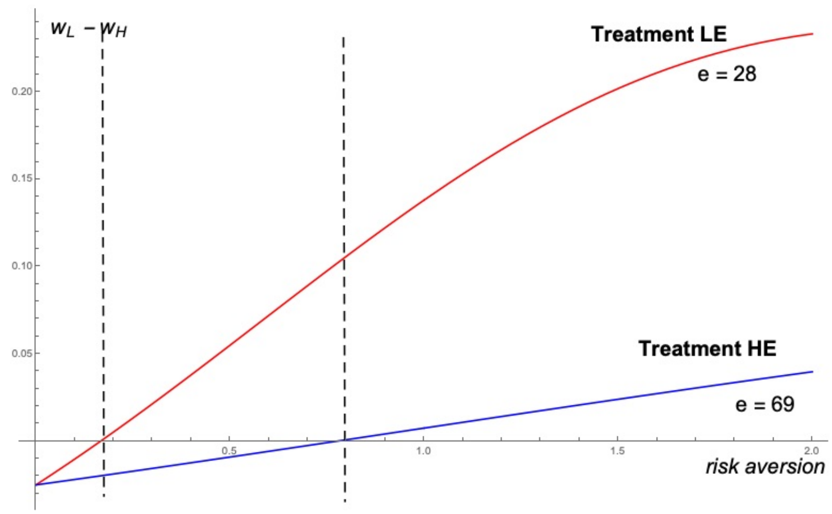


Figure 1: Threshold values with respect to different levels of risk aversion

equilibrium L only for treatment HE. In treatment LE, Equilibrium L becomes the better prediction. Finally, for all $r \in [0.78, +\infty[$, w_L is always higher than w_H irrespective of the treatment. Equilibrium L is now a better prediction than equilibrium H for both treatments. The following prediction summarizes these findings.

Prediction 2. *According to the LSB criterion built under the risk-averse retailers assumption:*

- $\forall r \in]0, 0.17[$ *equilibrium* H *is a better prediction than equilibrium* L *for both treatments.*

- $\forall r \in [0.17, 0.78[$, *equilibrium* H *is a better prediction than equilibrium* L *only in the treatment with a high initial endowment (HE). In the treatment with a low initial endowment (LE), Equilibrium L is the better prediction.*

- $\forall r \in [0.78, +\infty[$, *equilibrium* L *is then a better prediction than equilibrium* H *for both treatments.*

Finally, note that: (i) for both treatments the value $w_L - w_H$ increases with r; and (ii) for all $r \in]0, 1]$ the value $w_L - w_H$ increases at a higher rate in treatment LE than in treatment HE. In other words: (i) in both treatments the subset of beliefs supporting equilibrium L (bounded by w_L) increases with r more than the subset of beliefs supporting equilibrium H (bounded by w_H); and

(ii) this effect is stronger in treatment LE than in treatment HE. These results imply that under the assumption that the retailers are not risk-neutral, we should witness more equilibrium L played in treatment LE than in treatment HE.

Prediction 3. *When the retailers are risk-averse, participants should play more equilibrium L in the treatment with a low initial endowment (LE) than in the treatment with a high initial endowment (HE).*

4 Results

In this section, we first test Prediction 1 to 3 using statistical tests. There is no evidence of correlation between the participants' characteristics and their assigned treatment (see Appendix G). We then categorize the participants with respect to their lottery choices, and thus their levels of risk aversion. This enables us to test Prediction 2. Finally, we explore the decisions of suppliers and retailers using econometric regression on suppliers' and retailers' choices also using their elicited beliefs.

First, note that subjects interact in groups and groups are re-matched several times throughout the game. This feature occurs in each session and leads to an independence issue of observations inside each session. However, the aggregated observations across periods at the session level are independent. For the statistical tests, we get around the issue using a very conservative independence rule. We use the sessions as observations for our statistical tests, and end up with 9 observations per treatment. This is reflected in the large confidence intervals on the associated figures as this method also triggers less statistical power. Note that the statistical tests we run are the Mann Whitney tests (MW). The MW is a non-parametric test which allows for small sample sizes and deals with discrete outcomes. In our setting, we use them to test the hypothesis that the amount of subjects taking the choice of interest at the session level are identical between the two treatments. We display their "p-value" and their test statistic "z". Applying the same significance level as Eguia *et al.* (2018), we reject the hypothesis when the p-value is less than (or equal to) 0.10.

Second, turning to the econometric analysis, we use the finest level of observations as observations, but cluster the standard errors at the session level. We thus allow the observations to be dependent within sessions but we assume sessions are independent of each other. In addition, we account for subjects' and sessions' heterogeneity using random effects. As above, we consider the coefficient to be significant whenever the p-value is less than (or equal to) 0.10.

4.1 Test of predictions

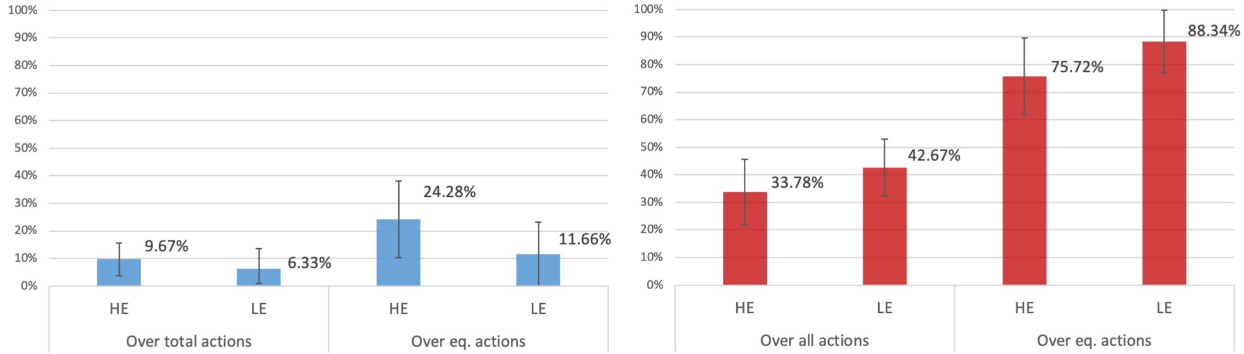
In this section we test the realization of our predictions.[13] An analysis of the equilibrium actions of the players informs us about the realization of Predictions 1 and 3. Regarding Prediction 2, we first define the mean level of retailers' risk aversion in order to test the realization of the prediction for this level of risk aversion.

4.1.1 Analysis of the equilibrium actions

Prediction 1. Let us first consider the prediction of the largest set of beliefs criterion without the extension of risk averse players. In that case, the criterion predicts that equilibrium actions H should be dominant in the two treatments. Figure 2a displays the percentage of equilibrium actions H over all possible actions and over equilibrium actions. We find that equilibrium actions H constitute a small fraction of the other actions or equilibrium actions. Actually, they constitute less than 10% of all actions and less than 25% of equilibrium actions.[14] The latter observation implies that more than 75% of equilibrium actions are equilibrium actions L as there are only two possible equilibrium actions. In addition, although the difference between the percentage of equilibrium actions H over all actions is not significantly different between the treatments (Mann Whitney test displays $z = 1.642$ and $p = 0.101$), it is when we account for equilibrium actions only (Mann Whitney test displays $z = 1.810$ and $p = 0.070$). Therefore, the largest set of beliefs without the extension of risk averse players fails to predict the equilibrium actions and provides no support for the effect between the two treatments.

[13] Note that, since the LSB criterion does not depend on the form of supplier's utility function (provided that it is increasing with profit), the supplier's level of risk aversion in the experiment does not affect the LSB predictions.

[14] The total number of actions is 100 by session: there are 4 groups which play 25 periods, hence $4 \times 25 = 100$ possible actions.



(a) Equilibrium action H $\{(p^H, p^H), 1, 1\}$ (b) Equilibrium action L $\{(p^L, p^L), 2, 2\}$

Figure 2: Frequence of equilibrium actions by treatment

Prediction 3. Let us now turn to the prediction based on the largest set of beliefs criterion extended to risk averse players. Reminder that it predicts that equilibrium actions L should increase from the treatment with the high endowment (HE) to the treatment with the low endowment (LE) due to the presence of risk aversion (Prediction 3). Figure 2b displays the percentage of equilibrium actions L over all actions and over equilibrium actions. We note that equilibrium actions L form 33.78% of actions in treatment HE while they constitute 42.67% of them in treatment LE. A Mann Whitney test with sessions as independent observations shows that these percentages are significantly different from one another ($z = -1.687$ and $p = 0.091$). Thus, there is a significant rise of 8.89% in equilibrium actions L from treatment HE to treatment LE, which is consistent with Prediction 3.

4.1.2 Analysis of the retailers' risk aversion

To test Prediction 2, we must first analyze the distribution of risk aversion among retailers. This will serve to determine an average level of risk aversion in relation to which we will see whether equilibrium actions reflect the prediction of the criterion

Retailers' risk aversion. The risk elicitation task is a single-choice design where subjects are asked to choose one lottery from five different lotteries (Table 7 provides an overview of the task - note that the task displays outcomes in euro). The lotteries have the same probabilities of low and high outcomes (50%). However, the distance between the two outcomes in each lottery increases as the lottery reference number rises. This pattern makes lotteries with a lower reference number safer but associated with a lower expected payoff than lotteries with a higher reference number. For example, Lottery 1 provides a lower expected payoff than Lottery 2, but is safer. Therefore, a risk neutral subject will choose Lottery 5 which provides the best expected payoff whereas an extremely risk averse subject will pick Lottery 1, the safest lottery.

The risk elicitation task thus categorizes subjects into five groups with respect to the lottery they pick. We can then associate to each group an interval of levels of risk aversion. To do that, we compute the threshold levels of risk aversion which theoretically make subjects indifferent towards picking one lottery or the next (for example, the level of risk aversion of $r = 1.3$ makes a subject indifferent to picking either Lottery 1 or Lottery 2). Table 2 below summarizes the categorization.

Risk aversion	Preference	Range of relative risk aversion	Percentage of retailers	
			HE	LE
Extremely risk averse	Lottery 1	$r \geq 1.3$	6.9%	15.3%
High risk averse	Lottery 2	$1.3 > r \geq 0.5$	16.7%	15.3%
Middle risk averse	Lottery 3	$0.5 > r \geq 0.3$	34.7%	18.1%
Low risk averse	Lottery 4	$0.3 > r \geq 0.1$	4.2%	6.9%
Risk neutral	Lottery 5	$0.1 > r \geq 0$	37.5%	44.4%
Number of Subjects			72	72

Table 2: Categorization of risk aversion

We can now analyze the repartition of subjects into these categories. According to the theory, the retailers' levels of risk aversion play a major role in the determination of equilibrium actions. Table 2 displays the percentage of retailers in each category. We note that all categories are represented. We find that the number of risk-averse retailers (i.e. the number of retailers who chose a Lottery different from Lottery 5, the safe lottery), or alternatively the number of risk-neutral retailers, is not significantly different from one treatment to another (the Mann Whitney test displays $z = 1.043$ and $p = 0.30$).

Prediction 2. Let us now turn to the prediction by the largest set of beliefs criterion extended to risk averse players. From the previous section on risk aversion, we can determine an average level of risk aversion. However, it will not be totally trustworthy, as its computation depends on the maximum value of r that we consider. In what follows, we consider that the upper bound is 2. Then, the mean level of risk aversion of retailers is $\bar{r}_R \approx 0.46$.[15] And therefore, the extended criterion predicts that Treatment HE should display a majority of equilibrium actions H whereas Treatment LE should display a majority of equilibrium actions L (refer to Prediction 2). Note that Figure 2 displays the percentage of equilibrium actions L and H over all actions and over equilibrium actions. It establishes that Prediction 2 fails, for $\bar{r}_R \approx 0.46$, as Equilibrium actions L are dominant in the two treatments. Equilibrium actions L constitute more than 75% of equilibrium actions in each treatment. The distribution of retailers according to their risk aversion shows that neutral and low risk-averse retailers (those choosing lotteries 5 or 4) represent about half of the population in both treatments (see Table 2). If we exclude this population and focus on moderately to extremely risk-averse retailers (those choosing lotteries 3, 2 or 1) then we obtain an adjusted mean level of retailer risk aversion $\bar{r}_R^A \approx 0.81$.[16] For such an r, the extended criterion predicts that the HE and LE treatments should exhibit a majority of L equilibrium actions, which is validated by the experimental results. For the population of retailers choosing lotteries 3, 2, or 1, L equilibrium actions constitute more than 76% for the HE treatment and 93.6% for the LE treatment, which is consistent with Prediction 2.

4.1.3 The predictive power of the criterion

Goodness of fit. We address the predictive power of the criterion by comparing a measure of goodness of fit for the standard criterion (as defined by Eguia *et al.* (2018)) and the extended criterion (as considered in this work). As in Eguia *et al.* (2018), the measure of fit that we use is the percentage of observations in which the entire group behaved as predicted by a given equilibrium conditional on playing an equilibrium. Remember that in our game, the standard criterion is equivalent to specification of symmetric beliefs and predicts equilibrium actions H in the two treatments. In contrast, the extended criterion, based on the evaluated risk aversion of subjects ($\bar{r}_R \approx 0.46$), predicts equilibrium actions L in Treatment LE but equilibrium H in Treatment HE. From the

[15] We compute this level using Table 2 as follows: $[(6.9\%+15.3\%)\times 1.65+(16.7\%+15.3\%)\times 0.9+(34.7\%+18.1\%)\times 0.4+(4.2\%+6.9\%)\times 0.2+(37.5\%+44.4\%)\times 0.05]\times(72/144)\approx 0.46$

[16] Note that the variability of data around the mean, given by the coefficient of variation, is lower when we consider only the retailers choosing lotteries 3, 2 or 1, instead of all the retailers: 6.83% against 9.26%.

experimental results, we see that the extended criterion outperforms the standard one: 56.6% of equilibrium actions are consistent with the extended criterion, against 17.3% with the standard level (see Table 3). Note that the predictive power of the extended criterion increases significantly when we consider only the population of retailers with moderate to extreme risk aversion. More than 75% of equilibrium actions are then consistent with the extended criterion evaluated at $\bar{r}_R^A \approx 0.81$ (see Table 3).

	All data	HE	LE
All population ($r = \bar{r}_R \approx 0.46$)			
Symmetric beliefs / LSB (standard)	17.3%	22.2%	12.9%
Passive beliefs	82.7%	77.8%	87.1%
LSB (extended)	56.6%	22.2%	87.1%
Restricted population ($r = \bar{r}_R^A \approx 0.81$)			
Symmetric beliefs / LSB (standard)	24.2%	27%	20.2%
Passive beliefs / LSB (extended)	75.8%	73%	79.8%

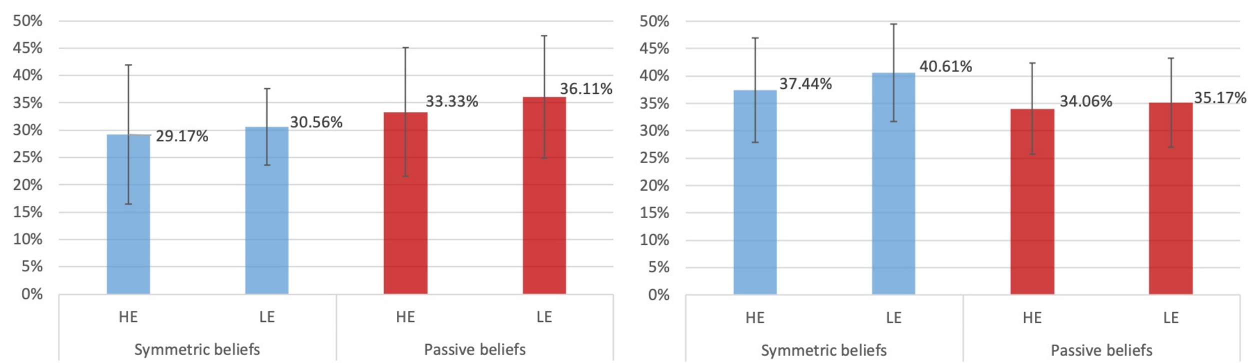
Table 3: Measure of fit of the different selection criteria in percentage of equilibrium played. [17]

Since equilibrium actions are in the large majority consistent with passive beliefs in both treatments (77.8% for HE and 87.1% for LE), we can ask whether specifying passive beliefs would be a better predictor than the extended criteria. To test this hypothesis, we provide an analysis of the beliefs elicited in the experiment. In particular, we investigate whether the elicited passive beliefs are consistent with the treatment effect of having more equilibrium actions L in the treatment LE than in the treatment HE (see Section 4.1.1). If so, we should have more passive beliefs elicited in the LE treatment than in the HE treatment.

Retailers' elicited beliefs. We investigate whether the elicited beliefs (first-period and aggregated) depend on the treatment that retailers play. Figure 3 displays the proportion of symmetric and passive beliefs by treatment. Figure 3a focuses on the retailers' beliefs at the first period whereas Figure 3b aggregates the beliefs across all the periods. We note that the proportions are similar between the treatments. The Mann Whitney tests confirms this pattern (the Mann Whit-

[17]When the entire population is considered, 832 equilibria are played, when the population excludes neutrals and low risk averse retailers, 215 equilibria are played.

ney tests of first-period beliefs gives respectively for symmetric and passive beliefs ($z = -0.139$, $p = 0.89$) and ($z = -0.461$, $p = 0.64$) ; the Mann Whitney tests of aggregated beliefs gives respectively for symmetric and passive beliefs ($z = -0.662$, $p = 0.51$) and ($z = -0.443$, $p = 0.66$)). This means that the treatment variable does not affect the retailers' beliefs. Thus, the presence of passive beliefs cannot explain why we find more equilibrium actions L in the LE treatment than in the HE treatment. This result raises the limitations of the ad hoc specification of beliefs (whether passive or symmetric) as a good predictor of the equilibrium played. Note that if we focus only on the population of moderate to extreme risk-averse retailers (those choosing lotteries 3, 2, or 1), the extended criterion emerges as a better predictor than the ad hoc passive belief specification. Since for $\bar{r}_R^A \approx 0.81$ the equilibrium selected by the extended criterion is the one supported by the passive beliefs, the goodness-of-fit measures of the criterion and passive beliefs are de facto the same. However, while the criterion is consistent with the observed treatment effect, this is not the case for the elicited beliefs.



(a) Beliefs at Period 1

(b) Beliefs aggregated along periods

Figure 3: Proportion of beliefs by treatment

4.1.4 The main results

The main results related to the realization of our predictions can be summarized in two points:

- First, the analysis of equilibrium actions shows a treatment effect: participants in the treatment with a low initial endowment (LE) play the L equilibrium action significantly more than those in the treatment with a high initial endowment (HE). This treatment effect is predicted by the criterion extended to risk-averse retailers, but not by the standard criterion.

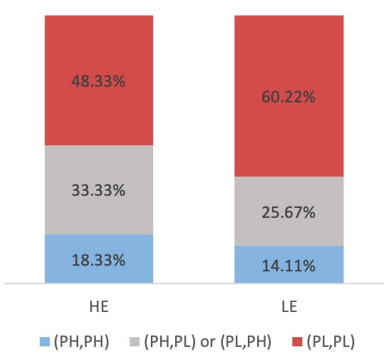
- Second, we find that extending the LSB criterion to risk-averse retailers improves its predictive power on the equilibria played, especially for a population of retailers with moderate to extreme risk aversion.

We now elaborate on the suppliers' and retailers' behaviors.

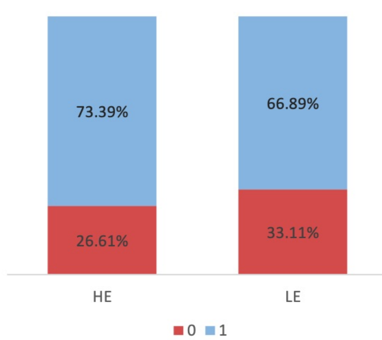
4.2 Analysis of the suppliers' and retailers' behaviors

To get more information on the role of actors in the equilibrium selection process, in this section we analyze the suppliers' and retailers' behaviors by performing some regression models. After displaying the general partition of the subjects' choices, we study the suppliers' pricing over time. As for the retailers, we focus on the role of elicited risk attitudes and beliefs.

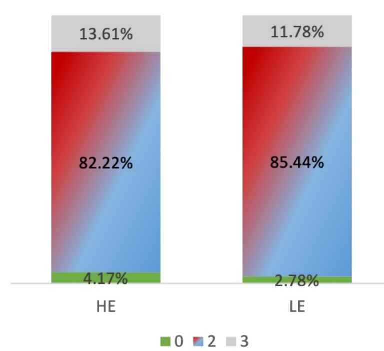
Figure 4 below summarizes the partitioning of subjects' choices with respect to the treatment they play in. We have also put in red the decisions in line with equilibrium L and in blue the decisions in line with equilibrium H.



(a) Suppliers' price offers



(b) Retailers' reactions to p^H



(c) Retailers' reactions to p^L

Figure 4: Repartition of the suppliers' and retailers' choices

4.2.1 Suppliers' offers

Consider the suppliers' pricing decision. Figure 4a provides an overview of the partition of the supplier's offers. We note that: (i) the symmetric low price offer (p^L, p^L) prevails in both treatments (around 48% of price offers in Treatment HE and 60% of price offers in Treatment LE); and (ii) the symmetric price offer (p^L, p^L) is more present in treatment LE than in treatment HE with an increase of around 12%. In other words, it seems that suppliers offer more equilibrium prices associated with equilibrium L from treatment HE to treatment LE.

	Coef.	Robust Std. Err.	Odds Ratio	z	Pr $> \|z\|$
Treatment LE	0.75	0.33	2.11	2.29	0.02
Period	0.04	0.02	1.04	1.84	0.07
Treatment LE * Period	−0.01	0.03	0.99	−0.25	0.80
Cut 1	−1.30	0.18			
Cut 2	0.57	0.20			
Session variance	0.22	0.33			
Subject variance	1.48	0.33			
Number of Observations			1 800		
Number of Sessions			18		
Number of Subjects			72		
Log Likelihood			- 1569.70		
Wald χ^2			9.88		

Table 4: Three-level (session, subject, observation) mixed effects ordered logit regression of low prices with all periods, with clustering of standard errors by sessions. *Note: The dependent variable is the number of low prices which equals 0, 1 or 2 (the baseline is 0).*

To confirm the latter pattern, we perform a three-level mixed effects ordered Logit regression of low prices offered by suppliers as a function of treatment, period and the interaction between treatment and period. We run an ordered logit regression because the number of low prices is discrete (0, 1 or 2) and they are ordered. The mixed effects account for unobserved heterogeneity. In our setting, this heterogeneity is captured through a random effect for sessions and a random effect for subjects nested within sessions. In this model, the observations (a subject in a session at a given period) comprise the first level, the subjects comprise the second level, and the sessions comprise the third. Last, we also cluster the standard errors by sessions. That is to say, we assume the observations are independent across sessions (clusters) but not necessarily within sessions.

Table 4 displays the results. "Treatment LE" is a dummy variable that takes value one if the treatment is LE and zero otherwise. "Period" is a variable that accounts for the period when suppliers make their choice in treatment HE, while "Treatment LE * Period" accounts for the period when suppliers make their choice in treatment LE. We find that the coefficient of variable "Treatment LE" is significantly positive, which means that, all else being equal, a supplier is significantly more likely to offer a low price rather than a high price when it plays with a lower initial endowment. Note that the coefficient of the variable "Period" is also significantly positive, meaning that, all else being equal, a supplier in Treatment HE is more likely to offer a low price in later periods.

Variable	Coef.	z
Treatment LE	0.31*	1.94
Period	0.03**	2.20
Treatment LE * Period	-0.00	-0.05
L1.price	1.37***	7.11
L1.reject	1.10***	5.08
Cut 1	0.65	
Cut 2	2.42	
Number of Observations	1 728	
Number of Sessions	18	
Number of Subjects	72	
Log Likelihood	-1525.72	
Wald χ^2	95.88	

*** : p < .01, ** : $p < .05$, * : $p < .1$

Table 5: Dynamic ordered logit regression of low prices with clustering of standard errors by sessions. *Note: The dependent variable is the number of low prices which equals 0, 1 or 2 (the baseline is 0).*

Table 4 provides insights regarding the change of subjects' decisions over the periods. More precisely, Table 4 tells us that suppliers in treatment HE seem to offer more low prices as they play subsequent periods in the experiment. However, this pattern does not extend to suppliers in treatment LE. Next, we elaborate more on the dynamics on the suppliers' side. Table 5 offers a more dynamic perspective of the suppliers' play. It departs from the regression of Table 4 in two ways: (i) we add two new explanatory variables which are the dependent variables at the previous period: 1) "L1.price" which means we take the price lag in period $t-1$, and 2) "L1.reject" that takes value 1 if only one price PH is rejected at period t-1, 2 if two prices PH are rejected at period t-1 and 0 otherwise.[18] ii) ; and (ii) we do not consider random effects anymore due to the dynamics involved (but we continue to cluster the standard errors at the session level).

We note that the coefficients of the variables already considered remain significantly positive. In addition, we find that the coefficients of the new variables "L1.price" and "L1.reject" are significantly positive. This means that, all else equal, a supplier is more likely to offer a low price at period t if it has offered at least a low price in the previous period $(t-1)$. It also means that, all else being equal, a supplier is more likely to offer a low price at period t if it got a rejection of a high price in the previous period $(t-1)$.

4.2.2 Retailers' strategies

Consider now the retailers' quantity decisions. Figure 4b and Figure 4c provide overviews of the partition of the retailer's choices. From treatment HE to treatment LE, retailers seem to decide to buy 0 units at a higher frequency in the event of receiving p^H, there is an increase by around 6%. While there is no evidence of a behavioral change when they receive p^L, participants still decide to buy 2 units at p^L, irrespective of the treatment. Note nonetheless that the strategy to"buy 1 unit at the high price" prevails in the two treatments (around 73% in Treatment HE and 67% in Treatment LE).

We investigate whether retailers do indeed reject more high-price offers in treatment LE than in treatment HE. To do so, we perform three mixed-effects Logit regressions of the retailers' choices following a high price offer denoted by Model 1, Model 2 and Model 3. As we did previously, we also cluster the standard errors by sessions. Model (1) derives the simpler regression using the same explanatory variables as before: the type of treatment, the period, and the interaction between treatment and period. Model (2) refines the analysis based on the retailers' elicited level of risk aversion (see Table 2 for the categorization), and then Model 3 adds the retailers' elicited beliefs in the first period of the game.

[18] Consequently we have fewer observations.

Table 6 summarizes the logistic regressions. Note that upon a high price offer, retailers must choose between rejecting the offer (buy 0 units) and accepting the offer (buy 1 unit). Our dependent variable is therefore 'Reaction _ p^H' which takes value 1 for acceptance and 0 otherwise. Rejection is the automatic baseline choice in both regressions.

	Model 1		Model 2		Model 3	
Variable	Coef.	z-stat.	Coef.	z-stat.	Coef.	z-stat.
Treatment LE	-0.915***	-3.40	-0.827***	-2.95	-0.835***	-2.87
Period	0.002	0.14	0.002	0.14	0.000	0.04
Treatment LE × Period	0.029	1.43	0.029	1.43	0.029	1.41
Lottery 1 (extremely risk-averse)	-		-1.464*	-1.91	-1.479*	-1.90
Lottery 2 (high risk averse)	-		-0.101	-0.20	-0.096	-0.19
Lottery 3 (middle risk averse)	-		-0.154	-0.35	-0.158	-0.35
Lottery 4 (low risk averse)	-		0.436	1.09	0.437	1.11
Lottery 5 (risk neutral)	-		0	(omitted)	0	(omitted)
Start with passive beliefs					-1.243***	-3.49
Start with symmetric beliefs					2.382***	2.86
Constant	1.57***	11.23	1.714***	6.39	1.735***	6.49
Session variance	0.00		0.00		0.00	
Subject variance	3.59		3.35		3.34	
Number of Observations	3600		3600		3600	
Number of Sessions	18		18		18	
Number of Subjects	144		144		144	
Log Likelihood	-1666.96		-1662.93		-1650.56	
Wald χ^2	11.58		21.76		76.50	

*** : p < .01, ** : $p < .05$, * : $p < .1$

Table 6: Mixed effects (nested) Logit regressions on retailers' strategies following offer p^H, with clustering of standard errors at the session level. *Note: the dependent variable is the acceptance decision which equals 0 or 1 (the baseline is 0, hence rejection is the baseline)*

Model 1. In the basic model, Model 1, the coefficient of the variable "Treatment LE" is significantly negative which tells us that, all else being equal, a retailer is less likely to accept a high price offer (or buy one at a high price) when it is in treatment LE. This feature confirms our treatment effect and we observe that it is stable across the other models (see the coefficient of the same variable in Model 2 and 3).

Model 2. Model 2 accounts for retailers' risk aversion. It adds the variables "Lottery k'" with $k \in \{1, 2, 3, 4, 5\}$ which is a dummy variable that takes value 1 whenever a subject has chosen Lottery k. The coefficient of "Lottery 5" is nil because "Lottery 5" is taken as the baseline choice. We find, in addition to the previous result, that the coefficient of the variable Lottery 1 is significantly negative. It means that, all else being equal, a retailer is less likely to accept a high price offer when it chooses Lottery 1 rather than Lottery 5. In other words, all else being equal, a retailer is less likely to accept a high price offer when it is extremely risk averse rather than risk neutral. Note that the coefficient of this variable remains significantly negative in Model 3.

Model 3. Last, Model 3 accounts for the 1-Period beliefs of the players. Passive beliefs are such that a retailer thinks the other retailer gets low prices irrespective of what it itself receives. Symmetric beliefs are such that a retailer thinks the other retailer gets the same price as it itself receives. The variables are dummy variables and take value 1 whenever a retailer exhibit the associated belief. The baseline retailer in the model has neither symmetric nor passive beliefs. We find that the coefficient of "passive beliefs" is significantly negative whereas the coefficient of "symmetric beliefs" is significantly positive. This means that, all else being equal, a retailer is less (respectively more) likely to accept a high price offer when it exhibits passive (respectively symmetric) beliefs in the first period of the game. This is in line with the effect of those beliefs on the equilibrium actions. Passive beliefs support equilibrium actions L where rejection is the equilibrium strategy, and symmetric beliefs support equilibrium actions H where acceptance is the equilibrium strategy.

4.2.3 The main results

The main results related to the analysis of behaviors can be summarized in two points:

- First, the econometric analysis confirms a treatment effect: Suppliers offer more low prices in the LE treatment than in the HE treatment; and a retailer is less likely to accept a high price offer in the LE treatment than in the HE treatment.

- Second, we show that suppliers' pricing decisions change from period to period. All else being equal, a supplier is more likely to offer a low price in a given period if it offered at least one low price in the previous period or if it got a high price rejected in the previous period. For retailers, we do not observe such dynamics, but there is evidence that their willingness to accept (high) prices is influenced by their elicited risk attitudes and beliefs.

5 Conclusion

In this paper we have analyzed the behaviors of individuals in an experiment where a supplier offers secret contracts to two risk-averse retailers. This game has two pure strategy equilibria: one supported by symmetric beliefs and characterized by high prices and the monopoly outcome, and the other supported by passive beliefs and characterized by low prices and the Cournot outcome. In order to take into account the effect of retailers' risk aversion on the selection of the equilibrium, we consider the Largest Set of Beliefs criterion, proposed by Eguia *et al.* (2018), and extend it by taking into account the retailers' risk aversion. First, our results show that extending the LSB criterion to risk-averse retailers improves its predictive power on the equilibria played, especially for a population of retailers with moderate to extreme risk aversion. Second, our results show that the presence of risk aversion affects the size of the belief sets that support each equilibrium, and as a consequence, a variation of an initial endowment modifies the players' strategies and equilibrium actions. In this way we found that participants in the treatment with a low initial endowment play the low price equilibrium significantly more than those in the treatment with a high initial endowment.

In conclusion, ours results show that in environments where the retailer's risk sensitivity is high, the equilibrium supported with passive beliefs seem more plausible than the equilibrium supported with symmetric beliefs. Specifically, in our framework, our results indicate that the equilibrium outcome is more likely to be competitive when retailers' risk sensitivity is high. They contribute to the literature that considers that risk aversion may be a determinant of competition intensity. For instance, in oligopoly settings, Asplund (2002), show theoretically, and Anderson *et al.* (2012) demonstrates with an experiment, that risk aversion influences firms' best response strategies and may lead to more competition. We support this result and apply it to a vertical contracting game, showing that retailers' high risk sensitivity may result in lower price offers by suppliers and thus benefit consumers.

References

Ackert, L. F., Charupat, N., Church, B. K., and Deaves, R. (2006). "An experimental examination of the house money effect in a multi-period setting". *Experimental Economics*, **9**(1):5–16.

Anderson, L. R., Freeborn, B. A., and Hulbert, J. P. (2012). "Risk aversion and tacit collusion in a Bertrand duopoly experiment". *Review of Industrial Organization*, **40**(1):37–50.

Armantier, O. and Treich, N. (2013). "Eliciting beliefs: Proper scoring rules, incentives, stakes and hedging". *European Economic Review*, **62**:17–40.

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

Avenel, E. (2012). "Upstream capacity constraint and the preservation of monopoly power in private bilateral contracting". *The Journal of Industrial Economics*, **60**(4):578–598.

Banal-Estañol, A. and Ottaviani, M. (2006). "Mergers with Product Market Risk". *Journal of Economics & Management Strategy*, **15**(3):577–608.

Blanco, M., Engelmann, D., Koch, A. K., and Normann, H.-T. (2010). "Belief elicitation in experiments: is there a hedging problem?" *Experimental Economics*, **13**(4):412–438.

Clark, J. (2002). "House money effects in public good experiments". *Experimental Economics*, **5**(3):223–231.

Costa-Gomes, M. A., Huck, S., and Weizsäcker, G. (2014). "Beliefs and actions in the trust game: Creating instrumental variables to estimate the causal effect". *Games and Economic Behavior*, **88**:298 – 309.

Crosetto, P. and Filippin, A. (2015). "A theoretical and experimental appraisal of four risk elicitation methods". *Experimental Economics*, pages 1–29.

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.

Davis, L. R., Joyce, B. P., and Roelofs, M. R. (2010). “My money or yours: house money payment effects”. *Experimental Economics*, **13**(2):189–205.

Durham, Y. (2000). “An experimental examination of double marginalization and vertical relationships”. *Journal of Economic Behavior & 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 & Organization*, **68**(1):1–17.

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

Fischbacher, U. (2007). “z-Tree: Zurich toolbox for ready-made economic experiments”. *Experimental Economics*, **10**(2):171–178.

Harrison, G., Lau, M., Ross, D., and Swarthout, J. T. (2017). “Small stakes risk aversion in the laboratory: A reconsideration”. *Economics Letters*, **160**(C):24–28.

Harrison, G. and Rutstrom, E. (2008). “Risk aversion in the laboratory”. *Research in Experimental Economics*, **12**:41–196.

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

Holt, C. and Smith, A. M. (2016). “Belief elicitation with a synchronized lottery choice menu that is invariant to risk attitudes”. *American Economic Journal: Microeconomics*, **8**(1):110–39.

Jing, L. and Cheo, R. (2013). “House money effects, risk preferences and the public goods game”. *Economics Letters*, **120**(2):310 – 313.

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

Ma, L., Liu, F., Li, S., and Yan, H. (2012). "Channel bargaining with risk-averse retailer". *International Journal of Production Economics*, **139**(1):155 – 167. Supply Chain Risk Management.

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.

McAfee, R. P. and Schwartz, M. (1994). "Opportunism in multilateral vertical contracting: Nondiscrimination, exclusivity, and uniformity". *The American Economic Review*, **84**(1):210–230.

Moellers, C., Normann, H.-T., and Snyder, C. M. (2017). "Communication in vertical markets: Experimental evidence". *International Journal of Industrial Organization*, **50**:214–258.

Moffatt, P. G. (2015). *Experimetrics: Econometrics for Experimental Economics*. Macmillan International Higher Education. ISBN 978-1-137-45659-5. Google-Books-ID: HlkrCwAAQBAJ.

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

Pratt, J. W. (1964). "Risk Aversion in the Small and in the Large". *Econometrica*, **32**(1/2):122–136.

Rey, P. and Tirole, J. (1986). "The logic of vertical restraints". *The American Economic Review*, pages 921–939.

Rey, P. and Tirole, J. (2007). *A Primer on Foreclosure*, volume 3 of *Handbook of Industrial Organization*, chapter 33, pages 2145–2220. Elsevier.

Schotter, A. and Trevino, I. (2014). "Belief Elicitation in the Laboratory". *Annual Review of Economics*, **6**(1):103–128.

Smith, A. (2013). “Estimating the causal effect of beliefs on contributions in repeated public good games”. *Experimental Economics*, **16**(3):414–425.

Thaler, R. H. and Johnson, E. J. (1990). “Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice”. *Management Science*, **36**(6):643–660.

Wakker, P. P. (2008). “Explaining the characteristics of the power (crra) utility family”. *Health Economics*, **17**(12):1329–1344.

Appendices

A Proof of Lemma 1

To show equilibrium L and equilibrium H are Perfect Bayesian Equilibria in pure strategies (henceforth PBE), we show that no player deviates from equilibrium strategies given their beliefs and that these beliefs are consistent with equilibrium choices. We begin with the proof for equilibrium L and finish with the proof for equilibrium H.

- Proof equilibrium L

To prove the existence of the equilibrium L we consider "passive beliefs". We focus our proof on the case where $r = 0$. As the level of r doesn't modify the preferences over the payoffs our proof then extends to all values of r considered in our analysis.[19] In this equilibrium, the supplier sets $p^L = 15$ to both retailers thinking each retailer rejects $p^H = 36$ while buys 2 units at $p^L = 15$. Each retailer rejects p^H while buys 2 units at p^L thinking the supplier sets p^L to both retailers. It boils down to the following strategy vector $((p^L, p^L), (0, 2), (0, 2))$.

Retailers do not deviate. (i) On-path and given the beliefs, the price offered is $p^L = 15$, and the retailer i earns $\pi_i(q_i, 2) = e - 33 + P(q_i + 2)q_i - 15q_i$ if $q_i > 0$ and $\pi_i(q_i, 2) = e$ otherwise. We find $\pi_i(0, 2) = e$, $\pi_i(1, 2) = e - 2$, $\pi_i(2, 2) = e + 27$, and $\pi_i(3, 2) = e + 6$ which implies that $\pi_i(2, 2)$ is higher than the other profits for all admissible value of e. The retailer does not deviate on-path. (ii) Off-path and given beliefs, the price offered is $p^H = 36$, the retailer i earns $\pi_i(q_i, 2) = e - 33 + P(q_i + 2)q_i - 36q_i$ if $q_i > 0$ and $\pi_i(q_i, 2) = e$ otherwise. We find $\pi_i(0, 2) = e$, $\pi_i(1, 2) = e - 23$, $\pi_i(2, 2) = e - 15$, and $\pi_i(3, 2) = e - 57$ which implies that $\pi_i(0, 2)$ is higher than the other profits for all admissible value of e. The retailer does not deviate off-path.

Supplier does not deviate. Given the beliefs, the suppliers earns $\pi_0(p^L, p^L) = 15\times2+15\times2 = 60$. If it deviates bilaterally or multilaterally, it respectively earns $\pi_0(p^H, p^L) = 36 \times 0 + 15 \times 2 = 30$ and $\pi_0(p^H, p^H) = 36 \times 0 + 36 \times 0 = 0$ which is less than the previous profit. The supplier does not

[19] Note that because our concave utility function only applies to positive payoffs, the domain set of the initial endowment for which equilibrium L and H hold shrinks: the initial endowment must rise and reach a sufficiently high level to avoid negative payoffs.

deviate.

Belief consistency. Given beliefs, we see that each retailer rejects p^H and buys 2 units at p^L while the supplier offers p^L to both retailers. Therefore, beliefs are consistent; Equilibrium L is a PBE with passive beliefs.

- Proof equilibrium H

To prove the existence of equilibrium H we consider "symmetric beliefs". As previously, we focus our proof on the case where $r = 0$. In this equilibrium, the supplier sets $p^H = 36$ to both retailers thinking each retailer buys 1 unit at $p^H = 36$ while buys 2 units at $p^L = 15$. Each retailer buys 1 unit at p^H while buys 2 units at p^L thinking the supplier sets $p_i = p^H$ to both retailers. It boils down to the following strategy vector $((p^H, p^H), (1, 2), (1, 2))$.

Retailers do not deviate. (i) On-path and given the beliefs, the price offered is $p^H = 36$, and the retailer earns $\pi_i(q_i, 1) = e - 33 + P(q_i + 1)q_i - 36q_i$ if $q_i > 0$ and $\pi_i(q_i, 1) = e$ otherwise. We find $\pi_i(0, 1) = e$, $\pi_i(1, 1) = e + 31$, $\pi_i(2, 1) = e - 13$, and $\pi_i(3, 1) = e - 6$ which implies that $\pi_i(1, 1)$ is higher than the other profits for all admissible value of e. The retailer does not deviate on-path. (ii) Off-path and given the beliefs, the price offered is $p^L = 15$, and the retailer earns $\pi_i(q_i, 2) = e - 33 + P(q_i + 2)q_i - 15q_i$ if $q_i > 0$ and $\pi_i(q_i, 2) = e$ otherwise. We find $\pi_i(0, 2) = e$, $\pi_i(1, 2) = e - 2$, $\pi_i(2, 2) = e + 27$, and $\pi_i(3, 2) = e + 6$ which implies that $\pi_i(2, 2)$ is higher than the other profits for all admissible value of e. The retailer does not deviate off-path.

Supplier does not deviate. Given the beliefs, the supplier earns $\pi_0(p^H, p^H) = 36\times1+36\times1 = 72$. If it deviates bilaterally or multilaterally, it respectively earns $\pi_0(p^H, p^L) = 36 \times 1 + 15 \times 2 = 66$ and $\pi_0(p^L, p^L) = 15 \times 2 + 15 \times 2 = 60$ which is less than the previous profit. The supplier does not deviate.

Belief consistency. Given beliefs, we see that each retailer buys 1 unit at p^H and buys 2 units at p^L while the supplier offers p^H to both retailers. Therefore, beliefs are consistent; Equilibrium H is a PBE with symmetric beliefs.

B Proof of Lemma 2

After observing the out-of-equilibrium offer $\bar{p}_i = p^H$, retailer i does not deviate from the equilibrium L by purchasing one unit rather than zero unit whenever:

$$w(p^H_{-i}|\bar{p}_i = p^H).u(\pi_i(1,0,36)) + (1 - w(p^H_{-i}|\bar{p}_i = p^H)).u(\pi_i(1,3,36)) \leq u(e) \text{ or}$$
$$w(p^H_{-i}|\bar{p}_i = p^H).u(e - 33 + 103 - 36) + (1 - w(p^H_{-i}|\bar{p}_i = p^H)).u(e - 33 + 46 - 36) \leq u(e), \text{ or}$$
$$w(p^H_{-i}|\bar{p}_i = p^H) \leq w_{L_{1/0}} \equiv \frac{u(e) - u(e-23)}{u(e+34) - u(e-23)}$$

Similarly, purchasing two units (respectively three units) is not a profitable deviation whenever $w(p^H_{-i}|\bar{p}_i = p^H) \leq w_{L_{2/0}} \equiv \frac{u(e)-u(e-15)}{u(e+95)-u(e-15)}$ (respectively $w(p^H_{-i}|\bar{p}_i = p^H) \leq w_{L_{3/0}} \equiv \frac{u(e)-u(e-57)}{u(e-3)-u(e-57)}$).

As a consequence, the subset of retailer i's belief $w(p^H_{-i}|\bar{p}_i = p^L) \leq w_H$, with $w_L = \min\{w_{L_{1/0}}, w_{L_{2/0}}, w_{L_{3/0}}\}$, implies that purchasing either one, two or three units is not a profitable deviation from the equilibrium L after observing the out-of-equilibrium offer $\bar{p}_i = p^H$. This subset supports then the equilibrium L.

C Proof of Lemma 3

After observing the out-of-equilibrium offer $\bar{p}_i = p^L$, retailer i does not deviate from the equilibrium H by purchasing three units rather than two units whenever:

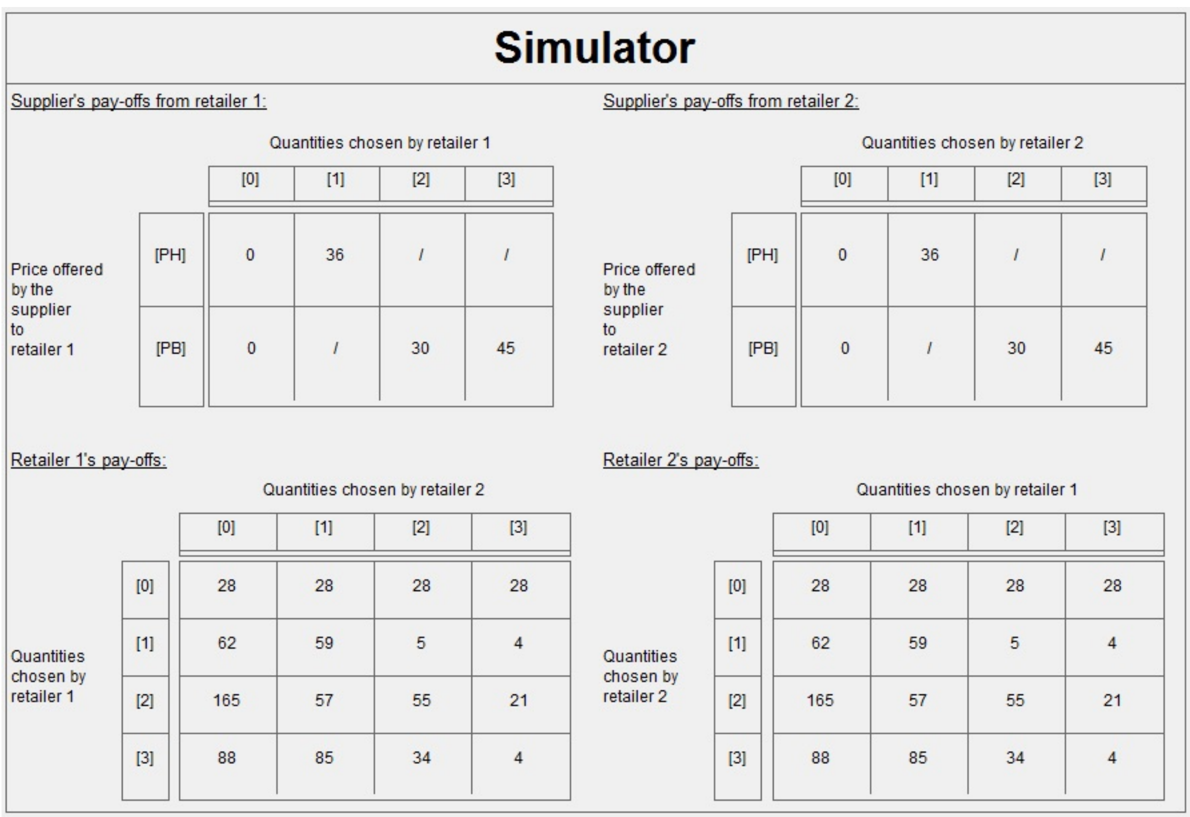
$$w(p^H_{-i}|\bar{p}_i = p^L).u(\pi_i(3,1,15)) + (1 - w(p^H_{-i}|\bar{p}_i = p^L)).u(\pi_i(3,2,15))$$
$$\leq w(p^H_{-i}|\bar{p}_i = p^L).u(\pi_i(2,1,15)) + (1 - w(p^H_{-i}|\bar{p}_i = p^L)).u(\pi_i(2,2,15)) \text{ or}$$
$$w(p^H_{-i}|\bar{p}_i = p^L).u(e - 33 + 3(45 - 15)) + (1 - w(p^H_{-i}|\bar{p}_i = p^L)).u(e - 33 + 3(28 - 15))$$
$$\leq w(p^H_{-i}|\bar{p}_i = p^L).u(e - 33 + 2(46 - 15)) + (1 - w(p^H_{-i}|\bar{p}_i = p^L)).u(e - 33 + 2(45 - 15)) \text{ or}$$
$$w(p^H_{-i}|\bar{p}_i = p^L) \leq w_{H_{3/2}} \equiv \frac{u(e+27) - u(e+6)}{u(e+57) - u(e+6) + u(e+27) - u(e+29)}.$$

Similarly, purchasing on unit (respectively zero unit) is not a profitable deviation whenever $w(p^H_{-i}|\bar{p}_i = p^L) \leq w_{H_{1/2}} \equiv \frac{u(e+27)-u(e-2)}{u(e+52)-u(e-2)+u(e+27)-u(e+29)}$ (respectively $w(p^H_{-i}|\bar{p}_i = p^L) \leq w_{H_{0/2}} \equiv$

$\frac{u(e+27)-u(e)}{u(e+27)-u(e+29)})$.

As a consequence, the subset of retailer i's belief $w(p^H_{-i}|\bar{p}_i = p^L) \leq w_L$, with $w_L = \min\{w_{H_{0/2}}, w_{H_{1/2}}, w_{H_{3/2}}\}$ implies that purchasing either zero, one, or three units is not a profitable deviation from the equilibrium H after observing the out-of-equilibrium offer $\bar{p}_i = p^L$. This subset supports then the equilibrium H.

D Simulator of payoffs for treatment LE



Simulator

Supplier's pay-offs from retailer 1:

Quantities chosen by retailer 1

Price offered by the supplier to retailer 1		[0]	[1]	[2]	[3]
	[PH]	0	36	/	/
	[PB]	0	/	30	45

Supplier's pay-offs from retailer 2:

Quantities chosen by retailer 2

Price offered by the supplier to retailer 2		[0]	[1]	[2]	[3]
	[PH]	0	36	/	/
	[PB]	0	/	30	45

Retailer 1's pay-offs:

Quantities chosen by retailer 2

Quantities chosen by retailer 1		[0]	[1]	[2]	[3]
	[0]	28	28	28	28
	[1]	62	59	5	4
	[2]	165	57	55	21
	[3]	88	85	34	4

Retailer 2's pay-offs:

Quantities chosen by retailer 1

Quantities chosen by retailer 2		[0]	[1]	[2]	[3]
	[0]	28	28	28	28
	[1]	62	59	5	4
	[2]	165	57	55	21
	[3]	88	85	34	4

Figure 5: Screenshot of simulator of players' pay-offs

E Issues on belief elicitation methods in the experiment

Beliefs and equilibrium actions. In the experiment, we elicit both actions and beliefs, which raises questions as to whether eliciting beliefs might change the action or not. This issue is discussed in the literature in which incentives for truthful reporting are based on the realization of a random variable by means of Proper Scoring Rules (PSR). Basically, a scoring rule measures the accuracy of a probabilistic prediction and its form can be linear, quadratic, logarithmic, etc. The reported results in this literature are inconclusive. Whereas some papers, albeit few (e.g. Smith, 2013 and Costa-Gomes *et al.*, 2014), report preliminary evidence of a causal effect between elicited beliefs and equilibrium actions in subjects' play, most papers state that there is no evidence of such an impact (Blanco *et al.*, 2010; Schotter and Trevino, 2014; Holt and Smith, 2016). In our experiment, the presence of a simulator should limit this impact insofar as participants can already have a clear overview of the impact of their actions. The additional understanding brought by the belief elicitation should be minimized.

Hedging. In the experiment, the payoff of the game divides into the payoffs from the action and the payoff from the belief elicitation task. As we pay both actions and beliefs, the validity of the elicitation might be challenged by hedging motives. Subjects might use stated beliefs to hedge against adverse outcomes in the rest of the experiment. While hedging can indeed be a problem in belief-elicitation experiments, it is less likely to be so when the hedging possibilities are not strong and prominent (Blanco *et al.*, 2010; Armantier and Treich, 2013; Schotter and Trevino, 2014). In our experiment, the retailer's payoff, if its stated belief is correct, is 40 ECU (2 €), which is a small fraction of its average payoff to the game. Thus, the risk of hedging is minimized.

F Risk elicitation task

Table 7 provides an overview of our risk elicitation task. We depart from the test designed by Crosetto and Filippin (2015) in their "EG treatment" (in line with Eckel and Grossman (2002, 2008)'s test (EG test/task) procedure) and divide all the outcomes by one half (due to budget constraints). Given the CRRA utility this theoretically does not affect the answers of the participants (see Moffatt (2015)). 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

Number	Probabilities	Gains
1	50 %	2 €
	50 %	2 €
2	50 %	3 €
	50 %	1.5 €
3	50 %	4 €
	50 %	1 €
4	50 %	5 €
	50 %	0.5 €
5	50 %	6 €
	50 %	0 €

Table 7: The ordered lottery selection (Eckel & Grossman's method)

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.

G Participants' characteristics

This appendix gives an overview of the participants' demography across the two treatments. Participants were randomly assigned a session. It was however still possible that their characteristics might be correlated with the type of treatment afterwards. In order to fully extract the impact of the initial endowment on the participants' behaviors, we check that there is no correlation between the participants' characteristics and the type of treatment they played.

Table 8 summarizes the distributions of the participants' demographic characteristics. Let us remind that there are 12 subjects per sessions. In this table, μ denotes the mean and σ denotes the standard deviation. We ran two Mann Whitney tests (MW) and a Kolmogorov-Smirnov test (KS) to verify whether the two samples of subjects were identical. Statistical tests confirm that the participants' characteristics are not significantly different between the two treatments: KS for age gives $p = 0.699$, the MW for gender gives $z = 0.091$ and $p = 0.928$, and the MW for field of study gives $z = -0.223$ and $p = 0.823$.

Treatment	HE		LE	
	μ	σ	μ	σ
Gender (number of males per session)	5.67	0.50	5.55	0.41
Age (years)	20.57	0.20	20.56	0.11
Field (number of subjects who study sciences per session)	6.11	0.82	6.77	0.85
Number of independent observations (i.e. number of sessions)	9		9	
Number of subjects per session	12			
Total number of subjects in the experiment	216			

Table 8: Participants' demographic characteristics

We conclude that there is no evidence of correlation between the participants' characteristics and their assigned treatment.