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Learning from Strike

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Résumé / *Abstract*

Ce papier présente une étude expérimentale sur l'influence des asymétries d'information et de la diffusion de l'information entre firmes sur l'issue des négociations. Nous proposons un prolongement ainsi qu'un test du modèle de Kuhn et Gu (1999) concernant l'apprentissage dans des négociations séquentielles. Nous utilisons pour cela deux jeux d'ultimatum avec incertitude du coté du proposant. Les résultats expérimentaux montrent que l'hypothèse de Dunlop d'un biais inflationniste systématique des revendications salariales n'est jamais vérifiée et que conformément aux prédictions de Kuhn et Gu, la probabilité d'apparition d'une grève diminue en présence de diffusion de l'information. En effet, une révision des demandes en fonction du résultat des négociations passées est observée dans les données expérimentales. Pourtant, observer seulement le résultat des négociations passées et non le processus de négociation ne suffit à garantir une augmentation Pareto optimale des gains des joueurs. Les préoccupations d'équité entravent les effets bénéfiques de la diffusion de l'information entre firmes.

This paper reports on an experimental study of the influence of asymmetric information and information spillovers on bargaining outcomes. It develops and tests Kuhn and Gu (1999)'s model of learning in sequential wage negotiations, by means of two Ultimatum Bargaining Games with uncertainty on the proposer's side. Evidence shows that Dunlop's assertion of inflationary wage claims does not hold systematically and strike incidence is lowered by information spillovers, since claims are revised according to the previous bargaining outcomes. However, in the presence of fairness concerns, the ability to observe outcomes but not the bargaining process does not entail a reduction in information asymmetry sufficient to guarantee Pareto improving bargaining outcomes.

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Mots clés : Asymétrie d'information, Expérimantations, Apprentissage, Grève, Jeux d'ultimatum

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I. Introduction

The economic theory of strikes has long been dominated by the so-called "Hicks's paradox" in which a strike can never be Pareto-optimal *ex ante* (Hicks, 1963; Kennan, 1986). Sequential bargaining models under asymmetric information provide theoretical foundations to escape this paradox (Hayes, 1984; Card, 1990; Cramton and Tracy, 1992; Kuhn and Gu, 1999). When the firm is informed on its profitability, but not the union, Pareto-optimal *ex ante* strikes may occur between rational agents. When embarking on a strike, the union acquires information on the firm's profitability and may revise his claims. Consequently, the diffusion of information should reduce the strike incidence.

While the bulk of literature restricts the scope of bargaining and learning to a single firm context, except when analyzing wage spillovers among unionized markets, this paper forwards the collection by unions of information on bargaining outcomes in other firms from the same industry. Two conflicting views can then be opposed. Dunlop (1957) assumes that the observation of previously negotiated wage settlements entails an inflationary wage drift, inasmuch as these latter become a target to be reached by the following unions. In contrast, Kuhn and Gu (1999) sequential bargaining model under asymmetric information predicts an adjustment of union's beliefs and claims whenever unions are given to observe previous negotiations in correlated firms. This should therefore enable a reduction in the risk of conflict. The opposition between these approaches comes from Dunlop's focus on the role of emotions (envy or equity) in the definition of union claims. In contrast, from the study of a panel of Canadian contract negotiations, Kuhn and Gu conclude that unions' behavior is mainly motivated by the reduction of informational asymmetry. Nevertheless, they cannot directly invalidate Dunlop's assertion since they cannot measure emotional concerns.

This paper aims at estimating the role of information spillovers on both strike incidence and wage settlements by testing, through a laboratory experiment, a game directly inspired by Kuhn and Gu.

Econometric studies are constrained by the use of proxies of informational asymmetry. The formation of union's prior beliefs regarding the firm's profitability remain unobservable to the econometrician. Consequently, the models' outcomes are more frequently estimated than their very mechanisms. As remarked by Pencavel (1991), one is not always sure that the results of estimations really measure the implications of asymmetric information instead of the efficiency of proxies. Laboratory experiments, in allowing to control directly private and asymmetric information, may help in measuring its effects on behavior and interactions.

Like in Kuhn and Gu, we propose herein a model in which two union-firm pairs bargain in sequence over the share of a pie. We design each union-firm pair negotiation as a non cooperative Ultimatum Bargaining Game (UBG) with asymmetric information, since UBG enables to distinguish between rationality and emotions in bargaining situations. An UBG is a two-person bargaining game in which a proposer, here the union, proposes the division of a sum to a responder who either accepts or rejects this proposal; in case of acceptation, each receives the amount agreed upon, otherwise both players get nothing. Each union is informed about the distribution of probability regarding the state of the firm and on the degree of correlation between the 2 firms. In contrast, each firm is perfectly informed on her state. It should be noted that there is only little research on UBG which puts uncertainty on the proposer's side (Kagel, Kim and Moser, 1996; Forsythe, Kennan and Sopher, 1991a).

In order to test the link between information and bargaining outcomes, which cannot be estimated in Kuhn and Gu's econometric tests, we relax their constraint of a similarity between the information on the distribution of probability and the unions' beliefs about the state of the firm. Therefore, we are able to run two treatments of this game. In the "high-information treatment", the first union transfers cooperatively all his information set, including his belief and claim, to the second union. In the "low-information treatment", the second union is only informed on the outcome of the first negotiation. This can figure out the situation in which both unions belong to the same organization and the one in which they belong to different national unions. This design allows to test for the impact of learning on strike incidence and wage settlements, but also of the extent of information, i.e. the union organization, on bargaining outcomes.

Our results show that unions' claims follow Myerson (1984)'s revelation principle. Wage settlements are lower in the second firm since most unions revise their demand downward after a strike in the first firm. Dunlop's hypothesis of inflationary wage claim does not hold in most cases. However, it does not mean that emotions do not play. As predicted by Kuhn and Gu, in the presence of information spillovers, strike incidence is lower in following negotiations because, in learning from strike, unions decrease their claims. However, when information is restricted to the preceding negotiation outcome, it does not reduce significantly its incidence. Thus, the predictions of Kuhn and Gu are partially refuted. Employers' bargaining behavior, through their preference for equitable shares, remains a decisive component of the strike incidence and bargaining outcomes.

The remainder of this paper is organized as follows. Section 2 sums up Kuhn and Gu's model and presents our strike model and its predictions. Section 3 introduces the experimental design. Section 4 analyze experimental data. Section 5 concludes.

II. The Model

Consider the main hypotheses and predictions of Kuhn and Gu before a presentation of our strike game and its theoretical predictions.

A. Kuhn and Gu (1999)'s Model

Two union-firm pairs bargain sequentially over wages with asymmetric information.[1] The nature determines whether the profit gross of labor costs is Π_G, if the firm is in a good state, or Π_B, if the firm is in a bad state, with $\Pi_G > \Pi_B > 0$. Only the firm is perfectly informed on her state. The union

[1] Kuhn and Gu considers a one-shot take-it-or-leave-it bargaining game and then an infinite-horizon bargaining model with offers and counter-offers. For the sake of simplicity, we consider only the first model.

only knows the prior probability, p, that the firm is in a good state. The union makes a demand $d \in [0,\infty)$. If the firm rejects, i.e. a strike occurs, payoffs are null for both since their outside option is normalized to zero. If the firm accepts, the union obtains what he claimed for. The states of the two firms are correlated. $a \in [0,1]$ denotes the common knowledge coefficient of correlation between them. The conditional probabilities that the second firm is in a good state depending on the state of the first firm are:[2]

$$prob(G_2 / G_1) = a + (1-a)p \text{ if firm 1 is in the good state and}$$

$$prob(G_2 / B_1) = (1-a)p \text{ if firm 1 is in the bad state.}$$

Both unions have the same *ex ante* value of p ($p_1 = p_2 = p$). The second union is informed on the outcome of bargaining in the first firm, before posting his claim. Table 1 illustrates strategies and payoffs.

Let us consider first union 1 ("the leader"). If $p>b$ (with $b= \Pi_B / \Pi_G$), he should ask Π_G for himself. This demand will be accepted by a firm in a good state since in rejecting the firm would incur the cost of a strike. The demand is rejected by a firm in a bad state. Probability of a strike is *(1-p)*. If $p<b$, the union should make a low demand, Π_B, which is always accepted. Probability of a strike is zero.

Let us consider now union 2 ("the follower"). His strategy may be influenced by the outcome of the preceding negotiation which may enable him to adapt his belief. If the first union made a low demand ($p<b$), the second union is unable to learn anything from the preceding negotiation since this demand is accepted by both types of firm. His *ex ante* belief on firm 2 is unaffected and he

[2] The joint probabilities of good and bad states at firms 1 and 2 are given in the following table:

	Firm 2's state		
Firms 1's state	Good	Bad	
Good	$ap+(1-a)p^2$	$(1-a)p(1-p)$	p
Bad	$(1-a)p(1-p)$	$a(1-p)+(1-a)(1-p)^2$	(1-p)
	p	(1-p)	1

adopts the same behavior as the leader. No strike can occur. The follower may learn on the state of firm 1 only if union 1 has made a separating (high) demand. In this case, the firm is forced to reveal his state: a rejection means a bad state whereas an acceptance indicates a good state.

In the case that union 1 made a separating demand rejected by the firm, the occurrence of a strike in firm 1 leads union 2 to revise his *ex ante* belief. Union 2's updated prior that firm 2 is in a good state is $p_r = (1-a)p$. He makes a separating demand in claiming for Π_G only if $p_r > b$, therefore if $p > \frac{b}{(1-a)}$. His demand is accepted provided that firm 2 is in a good state. The threshold above which union 2 separates is thus higher than that of union 1. Claiming for a high wage although a strike occurred in the first firm means that union 2 is very optimistic. In the case that union 1 made a separating demand leading to a wage settlement, union 2 learns that firm 1 was in the good state. Thus, he updates his belief that firm 2 is in the good state: $p^r = a + (1-a)p$. He separates in claiming for Π_G only if $p_r > b$, therefore if $p > \frac{(b-a)}{(1-a)}$. His demand is accepted provided that firm 2 is in the good state.

Whenever $b < p < b/(1-a)$, union 2 exploits the information obtained from the preceding negotiation. He asks Π_G when the leader separated and no strike ensued and he asks Π_B when the leader separated but a strike occurred.

When union 2 learns from the preceding negotiation (column 2), learning reduces strike incidence ($(1-a)p(1-p) < (1-p)$), increases union 2's utility compared to union 1 who has no information ($p[a + (1-a)p]\Pi_G + (1-p)\Pi_B > p\Pi_G$), and firm 2's expected profit ($(1-p)(1-a)p(\Pi_G - \Pi_B) > 0$).

Table 1

Bargaining Strategies in Kuhn and Gu's One-Shot Bargaining Game

Priors	$p < b$	$b < p < b/(1-a)$	$b/(1-a) < p$
A. CLAIMS AND ACCEPTANCE DECISIONS			
A1. Union-Firm pair 1			
Union's claim	Π_B	Π_G	Π_G
Firm in a good state	Acceptation	Acceptation	Acceptation
Firm in a bad state	Acceptation	Rejection	Rejection
A2. Union-Firm pair 2			
Learning by Union 2 on Firm 1 state	Impossible	Possible	Possible
Union's claim	Π_B	Π_B if strike in firm 1 Π_G if wage settlement in Firm 1	Π_G
Firm in a good state	Acceptation	Acceptation	Acceptation
Firm in a bad state	Acceptation	Acceptation of Π_B Rejection of Π_G	Rejection
B. BARGAINING OUTCOMES			
B1. Union-Firm pair 1			
Strike probability	0	$(1-p)$	$(1-p)$
Expected wage (conditional on a settlement occurring)	Π_B	Π_G	Π_G
Expected profit	$p(\Pi_G - \Pi_B)$	0	0
Expected utility of the union	Π_B	$p\Pi_G$	$p\Pi_G$
B2. Union-Firm pair 2			
Strike probability	0	$(1-a)p(1-p)$	$(1-p)$
Expected wage (conditional on a settlement occurring)	Π_B	$\frac{[ap+(1-a)p^2]\Pi_G + [1-p]\Pi_B}{[ap+(1-a)p^2]+[1-p]}$	Π_G
Expected profit	$p(\Pi_G - \Pi_B)$	$(1-p)(1-a)p(\Pi_G - \Pi_B)$	0
Expected utility of the union	Π_B	$p[a+(1-a)p]\Pi_G + (1-p)\Pi_B$	$p\Pi_G$

However, a strike ensuing in the first firm has an ambiguous impact on striking activity in the second firm. On the one hand, on average, a strike tends to moderate wage claims and pushes settled wages downward. This moderation decreases the probability of a strike. On the other hand, a strike in the first firm makes the bad state more likely in the second firm, favoring the occurrence of a strike. Anyway, information on the previous negotiations does not motivate unions to inflate their wage demands compared to the union who negotiated first, but instead the reduction of information asymmetry allows them to adjust their strategy accordingly. Thus, Kuhn and Gu asserts that information spillovers are Pareto-improving rather than generating pathological processes, as forwarded by Dunlop.

B. The Strike Game

Our strike game is largely inspired by the one-shot bargaining model of Kuhn and Gu. However, it differs from it inasmuch as even though each union gets the same information on the distribution of probability, we allow for a differentiation of unions' beliefs. This relaxes an important restriction of the benchmark model which imposes their similarity, and allows us to study the extent of information spillovers and its impact.

Our game is designed as a double Ultimatum Bargaining Game with uncertainty on the proposer's side, involving two union-firm pairs which bargain in sequence. The choice of an UBG structure is motivated by the fact that it allows for a realistic representation of union-firm negotiation. In our game, union's strength derives from his being the first mover, but this strength is tempered by his being the weak informed party. In addition, many experiments on UBG have stated robust results, providing us with an empirical benchmark which our results can be confronted with. These works have notably identified the extent to which emotions play in this bargaining setting. Thus, it could help to disentangle learning and emotions in our bargaining setting.

Most research on bargaining with one-sided private information has put uncertainty on the responder: the proposer knows the realized pie size but the responder is not informed about the initial chance move.[3] To our knowledge, only few exceptions can be forwarded which put uncertainty on the proposer's side and offer a better representation of union-firm bargaining process. Kagel, Kim and Moser (1996) shows that the rejection rate in UBG is higher when the responder is given the lower payoff and lower when he gets the higher payoff, compared to full information on both sides. Forsythe, Kennan and Sopher (1991a)[4] considers a two-person pie-splitting game in a cooperative setting. It tests Myerson (1984)'s revelation principle stating that strike is a means for the union to devise incentive mechanism such as to make the firm reveal her type. From an experiment where subjects exchange messages, it shows that the theory does not withstand the facts since some strikes occur even though the good state prevails and the strike condition does not hold. However, strikes are more frequent whenever the bad state prevails and the strike condition holds.

Our ultimatum demand game also accounts for this revelation mechanism but in a non cooperative setting, in controlling for the unions' beliefs. Two treatments of this game have been run which differ in the extent of information spillover between the negotiating pairs. Whereas Kuhn and Gu assumes that the knowledge by each union of the first bargaining outcome is sufficient for a complete diffusion of information, our model introduces more conditions, i.e. the transfer of information on the first union's belief and claim.

The first treatment ("high-information" treatment, see instructions in Appendix A) involves two union-firm pairs bargaining in sequence, with both unions belonging to the same union organization and both firms to the same industry. Each union-firm pair bargains about the share of a pie. Each

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[3] Two categories of experiments are available (Croson (1996). On the one hand, some experiments control responders' beliefs over the pie size (Mitzkewitz and Nagel, 1993; Güth, Huck and Ockenfels, 1996), or observe the consequences of changes in the prior distribution in demand games (Rapoport, Sundali and Seale, 1996) or in offer games (Rapoport and Sundali, 1996). On the other hand, other experiments do not control for responder's priors (Straub and Murnighan, 1996; Croson, 1996; Güth and van Damme, 1998).

[4] Forsythe, Kennan and Sopher (1991b) proposes an experimental study of strikes in which the pie size declines over time as long as subjects argue about its division, but in complete information. Coursey (1982) offers a study of strikes when bargaining time is severely limited and information incomplete for both parties and he points out the role of information limitation.

pie amounts either to 30 or 100, depending on the business cycle. It is common knowledge that *i)* the distribution of probability regarding the state of nature is the same for the two firms and *ii)* the two firms are correlated such as the second firm is in the same state as the first one with probability 0.8.

The game is six-stepped. Consider the first bargaining pair in which the union is the proposer and the firm is the responder. Nature moves by determining whether the firm is in a good state (the pie amounts to 100) with probability 0.7 or in a bad state (the pie is 30) with probability 0.3. Then, negotiation starts up. In step 1, being only informed about the distribution of probability, the union determines his belief on the pie size (30 or 100) and his wage demand defined in interval [0,100]. In step 2, the firm is informed on the size of the pie. In the case that the demand is higher than the actual size of the pie, it is automatically rejected; both get nil. Otherwise, the firm decides either to reject the demand and both get a zero payoff, or to accept it. If an agreement has been reached, the union gets what he claimed for and the firm gets the difference between the actual pie and the union's claim. In step 3, each party is informed about his own payoff.

Consider the second negotiation, that is also designed as an UBG in which the union is the proposer and the firm is the responder. In step 4, since both belong to the same organization, the second union is privately informed on the first union's belief that the first firm is in a good state, his demand and his payoff. To his turn, he declares his belief (30 or 100) and he makes a demand to the second firm. In step 5, the second firm is informed on the size of the second pie and she decides on whether accept or reject the demand. If the demand is greater than the actual size of the pie, it is automatically rejected and both parties get nothing. Otherwise, the firm can either reject the demand and then both get zero, or accept the demand. After an agreement has been reached, the union obtains what he claimed for and the firm gets the difference between the actual pie and the union's payoff. In step 6, each party is informed about his own payoff.

A second treatment ("low-information" treatment, see instructions in Appendix B) has been designed with the same sequence and rules of bargaining as the high information treatment, except for one difference. The extent of information transferred to the second union has been reduced. The f information set only consists of the distribution of probability and the leader's payoff. Thus, the follower is only able to draw a belief on the leader's prior.

The comparison between these treatments aims at varying the institutional framework, since the low information treatment can figure out multi-unionism, whereas the high information treatment may correspond to a unique national organization. The major goal of the comparison is to draw out the impact of higher information spillovers on the probability of a conflict and on the average wage, conditional on a settlement occurring in the second round of negotiation.

C. Theoretical Predictions

The parameters of the game have received the following values. The firm's profit gross of labor costs takes the value $\Pi_G = 100$ in a good state and $\Pi_B = 30$ in a bad state. The probability associated with a good state is $p=0.7$. The degree of correlation between the firms is $a = 0.8$. The optimal strategies depend on the relationship between the profit ratio, b, and the union's belief, p. $b = \frac{\prod_B}{\prod_G} = \frac{30}{100} = 0.3$. The inequality [$b < p < b/(1-a)$] leads to consider the intermediate case identified in Kuhn and Gu (see Table 1). The optimal strategies are given in Table 2.

The Nash equilibrium of this game is separating since the firm is forced to reveal her type. Since $p>b$, the leader should always make a separating demand and ask 100 (or $100 - e$) for himself. Firm 1 should accept this demand if in a good state since it is not worse than her alternative utility level, normalized to zero. If it turns out that the nature move has determined a bad state, this demand is automatically rejected and both subjects get 0. The probability for a strike to arise is 0.3. The union's expected payoff is 70 and the expected profit is 0. It should be noted that the first union should not care about what is happening in the following negotiation since it does affect neither his payoffs nor his employer's. As a matter of fact, this game is not a signaling game. Observing the settled wage in the first firm, the follower can learn from the preceding negotiation. Thus, the second union should condition his demand on the outcome he observes. Whenever no strike occurred and the settled wage is high in the first firm, he should infer the good state of firm 2 and claim for a high wage of 100. In contrast, observing a strike in the first firm should cause the follower to revise his *ex ante* belief downward and moderate his demand. Learning from strike pushes unions' claims downward and reduces the strike likelihood in the second firm. It also allows for a Pareto-improvement of both union's and firm's utility.

Table 2

Optimal Bargaining Strategies in the Strike Game

	Union-Firm pair 1	Union-Firm pair 2
A. *Claims and acceptance decisions*		
Union's claim	100	30 if strike in Firm 1 100 otherwise
Firm in the good state	Acceptation	Acceptation
Firm in the bad state	Rejection	Acceptation of 30 Rejection of 100
B. *Bargaining outcomes*		
Strike probability	0.3	0.042
Expected wage (conditional on a settlement occurring)	100	78.079
Expected profit	0	2.94
Expected Utility of the Union	70	74.8

These theoretical predictions are similar in both treatments. The common knowledge probability to face a good state, the correlation coefficient between the two firms and the information conveyed through the bargaining outcome constitute sufficient conditions for the subjects to behave according to these predictions. In equilibrium, there should be no difference in bargaining behavior or strike incidence across treatments.

These predictions state optimal strategies for selfish agents. Experiments on Ultimatum Bargaining Games have however revealed the systematic occurrence of more equal shares then theory predicts. A majority of proposers offer a fair share and unfair offers are frequently rejected by responders. Here, introducing fairness motivations would lead the first union expecting a good state of the firm to claim for 50 to 70 instead of 100, and the second union to claim for 15 to 20 instead of 30 whenever a strike occurred in the first firm. Anyway, the leader's demand remains separating since it cannot be accepted by a firm who is in the bad state.

Considering non selfish agents however changes learning opportunities. When the leader transfers his full information set, the follower becomes able to discriminate between three elements leading to a strike: the leader's behavior, the employer's decision and the state of the firm. He is able to establish a distinction between intentional and unintentional rejection of a claim by the first employer. He looses this discrimination capacity in the low information treatment. When the leader's payoff is 0, he is unable to disentangle between a wrong belief regarding the state of the firm and the exercise of her veto power by the firm, induced itself either by the union's greediness or by the employer's toughness. We thus state the hypothesis that, with agents motivated by fairness concerns, conflicts are more likely to occur when information spreads less. If the risk of conflict is denoted r_i, with $i \in \{1,2\}$, we should observe the following inequality $r_{2High} < r_{2Low} < r_1$.

III. Experimental Design

The experiment consisted of 6 sessions and each session consisted of 20 periods. These sessions were conducted at GATE, University Lumière Lyon 2, France. 68 subjects were recruited from undergraduate courses in the Engineering Textile School. All of them were inexperienced in bargaining experiments. No subject participated in more than one session. The computer program separated the subjects into groups of size four. A total of 17 groups were formed. 9 groups played the high information treatment, 8 groups played the low information treatment. A partner matching protocol was in effect, in which group assignment remained constant throughout the session. This enables to get more independent observations than a stranger protocol. Moreover, panel data analysis allows for a control of possible time effects in the behavior of the fixed groups. All interactions were anonymous and the subjects were never informed about the identity of the participants they were matched with in a session. The experiment was computerized using ZTree software developed at Zurich University. On average, a session lasted one hour, excluding payment of subjects. All amounts were given in ECUs (Experimental Currency Units), with each ECU convertible to French Francs at 10 ECU=1FF at the end of the session.

Participants were randomly assigned to a specific computer terminal, depending on the number drawn randomly from a box upon entering the room. Before the experiment begins, written instructions were distributed to participants and read aloud by the experimenter. All participants were thus completely informed about the rules and parameters of the game. Questions were answered privately by the experimenter. Once the experiment began, no communication was allowed. Each subject then discovered on his computer screen the role he was assigned to. Role assignment remained constant for the entire session.

The size of the pies was randomly drawn before the experimental sessions and we used the same series of values for all the sessions in order to make comparisons across groups feasible. At the beginning of each period, the first union (subject A1 in this decontextualized experiment) had to declare his belief about the size of the pie and his demand. The first firm (subject B1) was then informed of the actual size of the pie and of the union's demand. He could then decide whether to accept or reject. Each was then informed on his respective payoff. Then, the second union-firm pair started to bargain. The second union (subject A2) was informed of the A1's payoff, and additionally of A1's belief and demand in the high information treatment. A2 could then decide on his own belief and demand. The second firm (subject B2) was informed of the size of the pie, but not on the outcome of the preceding negotiation since we were not interested in studying the effects of information spillovers on employers' behavior. Then he decided to accept or reject the demand. After a feedback on each party's payoffs, the round was over and the computer continued to the next period. At the end of each period, once all participants have completed their decisions, each could see an historic table displaying a summary of his decisions, the other player's reactions and his payoff, in all preceding periods.

At the end of the session, participants were requested to fulfill a post-experiment questionnaire. Then, their payoffs were converted from ECUs to French Francs and they were asked to move one by one to a separate room in order to get paid confidentially. There, they were given an envelop including their payment in cash. Payment consisted of the sum of payoffs in each period increased by an amount of 20 FF as a show-up fee.

IV. Experimental Results

This section presents a discussion of the overall statistics, before focusing on a panel data analysis of the role of information on, successively, unions' bargaining behavior and bargaining outcomes in the second round of negotiation.

A. General Results

Many differences arise from a comparison between the first and the second negotiations, as indicated in Table 3.

Consider the high information treatment. As predicted, whereas a large majority of unions who bargain first believe that the firm is in a good state, the second unions adjust their beliefs in taking into account the outcome of the first negotiation. A χ^2 test shows that the structure of beliefs significantly differs from one negotiation to the following at a 0% level. However, almost half of the second unions still believe that their firm is in a good state even though the first bargaining ended up by a conflict, attributing the responsibility of the strike to the employers' toughness.

Table 3

Summary Statistics

	High Information		Low Information	
	Firm 1	Firm 2	Firm 1	Firm 2
A. Belief and claims				
Rate of beliefs that pie=100	0.97	0.77	0.89	0.80
Rate of beliefs that pie=30	0.03	0.51 if strike in firm 1 0.05 otherwise	0.11	0.35 if strike in firm 1 0.09 otherwise
Average claim	54.58	51.36 [36.84 if strike in firm 1 60.18 otherwise)	54.63	48.73 [44.42 if strike in firm 1 52.01otherwise]
B. Bargaining Outcomes				
Rate of agreement in firms in the good state	0.85 (108/126)	0.88 (111/126)	0.78 (87/112)	0.80 (90/112)
Rate of agreement in firms in the bad state	0.07 (4/54)	0.30 (16/54)	0.08 (4/48)	0.19 (9/48)
Global strike rate	0.38 (68/180) in which 0.28 (19/68) non automatic	0.29 (53/180) in which 0.45 (24/53) non automatic	0.43 (69/160) in which 0.42 (29/69) non automatic	0.38 (61/160) in which 0.39 (24/61) non automatic
Average wage (conditional on a settlement occurring)	51.30	48.82	50.52	43.66
Average profit (conditional on a settlement occurring)	46.19	42.35	46.39	49.96
Average wage (unconditional)	31.92	34.45	28.73	27.01
Average Profit (unconditional)	28.74	29.88	26.38	30.91

Accordingly, followers' average wage claims are scaled down after a strike occurred in the first negotiation, and adjusted upward after an agreement was reached (this is the only case fitting with Dunlop's assertion). The differences in claims are significant at a 12% level according to a Wilcoxon Mann Whitney test. It should be noted that in both firms most unions make separating demands but they also exhibit a concern for fairness since they could make higher demands consistent with their beliefs. This reflects usual behavior in experiments on ultimatum bargaining game.

As predicted, most demands are accepted whenever the firms are in a good state and rejected otherwise. The overall rate of strike declines from 0.38 in the first bargaining set (close to the theoretical prediction of 0.3) to 0.28 in the second one. The adjustment of the second unions' claims allows to reach a higher rate of agreement in both types of firms, but especially in bad state firms where this rate reaches 0.3 against 0.07 in the first bargaining.

Even though decreasing, the rate of strike in the second negotiation remains however greater than predicted theoretically (0.04). This can be explained by opposing "automatic" and "non automatic" rejections. Automatic rejections occur whenever the union's demand is higher than the realized pie size, the only case accounted for by the theoretical model with selfish agents. Non automatic rejections are due to an intentional decision of the employer to reject acceptable demands. In our experiment, on the one hand, the claim moderation observed after a conflict is not sufficient to avoid automatic rejections in the second firm: despite their decrease in comparison with the first negotiation, they still generate 55% of the strikes. On the other hand, in the remaining 45%, equity considerations induce the firm to reject intentionally demands that are considered as being unfair. This also reflects usual behavior in UBG experiments.

As predicted, experimental evidence indicates both a decrease in the average wages whenever a settlement occurred and an overall increase of union's and employer's payoffs in the second negotiation. This results from both claim moderation and a sharp drop in the incidence of conflicts.

Consider now the low information treatment. The same tendencies are observed than in the high information treatment. In the second firms, unions revise their beliefs and claims downward after being informed on a strike occurring in the preceding negotiation. A χ^2 test shows that the distribution of beliefs is different between the first and the second negotiations, but similar to the high information treatment in the second firm, at a 4% level. A Wilcoxon Mann Whitney test accepts the null hypothesis of similar demand distributions in the first negotiation in both treatments at a 6% level. The same test rejects the null hypothesis of a similarity between the average claims made in the first and second negotiation at a 5% level. A Wilcoxon Mann Whitney test also rejects the hypothesis of different demand distributions in the second firms across treatments, at a 41% level. But this is no longer true if one considers the evolution of behavior over time. However, a change point test, significant at a 2% level, reveals that, from the middle of the game on, high informed unions increase their average demand (which amounts in average to 70% of the supposed pie size) after an agreement has been settled in the first firm. In contrast, in the low information treatment, such an evolution does not occur and unions continue to demand on average 60% of the expected pie size.

Regarding the fist negotiation, a c^2 test allows to conclude that there is no difference in the strike rates nor in the average payoffs between the two treatments, at a 1% level. As a consequence of the revision of beliefs and claims, like when high information spillovers are allowed, the rate of agreement in the second negotiation increases whatever the situation of the firm. However, the rate of strike remains significantly higher, at a 11% level, than when unions receive more information, as shown by a c^2 test. As predicted in considering fairness concerns, $r_{2High} < r_{2Low} < r_1$. Like in the high information treatment, a large proportion of strikes (39%) are due to intentional rejections of acceptable demands. However, whereas more information allows a decline in the share of automatic rejections in the overall strikes in the second negotiation, the share of non intentional rejections is stable when unions are less informed. Lastly, when an agreement has been reached, the average settled wage is lower in the second firm, like when unions are more informed. But, in contrast with the high information treatment, there is no significant difference in the average wage unconditional on a settlement among the first and second firms, as concluded by a Wilcoxon Mann Whitney test which rejects similarity at a 22% level. This is due to the incidence of strikes which remains higher when unions receive less information.

To sum up, experimental evidence from both treatments rejects the hypothesis of an inflationary wage claim emphasized by Dunlop, since unions revise their claims downward after having observed a strike occurring in the preceding negotiation. The average wage claim only increases after an agreement has been reached when unions are given more opportunity to learn. As in Kuhn and Gu (1999), learning from strike can allow to reduce conflict incidence and makes each party better off in most cases. Does this mean that behavior is entirely determined by learning? Information spillovers seem insufficient for achieving the predicted claim revision and emotions also play since employers do reject acceptable demands. While the extent of information favors the settlement of agreements by helping unions to revise their claims, it also induce a tougher behavior from the employers who intentionally reject more demands, which explains that average wages are considerably lower than predicted.

For a better understanding of the role of information and learning in bargaining behavior, a strict test of the structural model is performed, through panel data analysis. No control variables are added since the aim is to identify the pure effect of information variables. We perform OLS estimations on unions' demands and payoffs and probit regressions on unions' beliefs and strike incidence in the second negotiation. For each estimation, individual and time dimensions are taken into account, controlling for both possible heterogeneity. The results obtained with pooling data are tested against models with effects (LM test). Whenever the models with effects fit better the data, the OLS fixed effect model is tested against the random effect model (Hausman test). Similarly, the simple binomial probit models are tested against the random group and time effect models. Only the results of the best fitting models are presented below. The results on union behavior (beliefs and claims) are examined before those on bargaining outcomes.

B. Information, Unions' Beliefs and Claims

Unions' behavior in the second round of negotiation gives information a different weight according to its extent (see Table 4). When less informed, unions pay attention to the average unions' payoff in the first negotiation in revising their belief upward, as predicted by Kuhn and Gu, and their claim downward. This means that they learn from the preceding negotiation: the greater the first unions' payoff, the more likely the good state of the second firm, but also the higher the risk of intentional rejection by their employer if the demand is considered as feasible but unfair. The occurrence of a strike also lowers claims significantly. Information favors cautious behavior under low information condition.

Table 4

Determinants of Unions' Beliefs (Binomial Probit Model) and Claims (Least Squares with Individual Dummy Variables and Time Effects)

	High Information				Low Information			
	Beliefs (pie=100)		Claims		Beliefs (pie=100)		Claims	
Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	-1.3547 (0.8187)	0.0980	0.2407 (2.0027)	0.9045	0.1816 (0.5759)	0.7525	2.5634 (1.5196)	0.0936
Union's belief in the first negotiation	0.1464 (0.9688)	0.8799	8.5153 (2.6566)	0.0016	…	…	…	…
Union's claim in the first negotiation	0.0187 (0.0146)	0.2010	-0.0752 (0.05166)	0.1470	…	…	…	…
Union's payoff in the first negotiation	0.0445 (0.0331)	0.1788	-0.0982 (0.0688)	0.1552	0.0252 (0.0123)	0.0397	-0.0839 (0.0293)	0.0048
Strike in the first negotiation	0.0506 (1.6791)	0.9760	-7.0133 (4.0588)	0.0858	0.2096 (0.5965)	0.7253	-6.8904 (1.6555)	0.0001
Pseudo R^2	0.3660		…		0.1324		…	
χ^2	69.72486		…		21.1987		…	
Adjusted R-squared	…		0.9997		…		0.9997	

Note.- Standard errors are reported in parentheses. In the high information treatment (the low information treatment, respectively), the number of observations is 180 (160). In the Probit estimation, the value of the log-likelihood –61.7215 (–69.46502) and the value of the restricted log-likelihood is –96.5839 (–80.0644). The significance level of the χ^2 is 0.0000 (0.0002) and the percentage of good predictions is 0.83 (0.8). In the OLS estimations, the value of the log-likelihood is –475.2172 (–424.5319) and the value of the restricted log-likelihood is –1233.4833 (–1096.1833).

When unions are more informed, their claims are influenced positively by information on leaders' beliefs and negatively by information on the occurrence of a strike. Their behavior is not highly significantly influenced by the other unions' claims and wage, which challenges Dunlop's conjecture. Surprisingly, their beliefs are not determined by information spillovers. This contrasts with unions' behavior when they are given low information. This means that the determinants of unions' behavior cannot be restrained to information and learning.

C. Information, Strike Incidence and Payoffs

When information spillovers are large, a subset of information about the first bargaining influences the strike incidence (Table 5) and unions' payoffs (Table 6) in the second negotiation. This influence vanishes when information spillover is limited.

Table 5

Determinants of the Strike Incidence (Binomial Probit Model)

	High Information		Low Information	
Variable	Coefficient	P-value	Coefficient	P-value
Constant	1.0480 (0.6623)	0.1136	0.0177 (0.4579)	0.9692
Union's belief in the first negotiation	-0.2996 (0.7658)	0.6957	…	…
Union's claim in the first negotiation	0.0067 (0.0144)	0.6416	…	…
Union's payoff in the first negotiation	-0.0347 (0.0228)	0.1271	-0.0073 (0.0087)	0.3992
Strike in the first negotiation	-1.5293 (1.2799)	0.2321	-0.2561 (0.4826)	0.5957
Pseudo R^2	0.4224		0.0048	
c^2	9.2656		1.0256	

Note.- Standard errors are reported in parentheses. In the high information treatment, the number of observations is 180. The value of the log-likelihood is –104.4622 and the value of the restricted log-likelihood is –109.0950. The significance level of the c^2 is 0.0548 and the percentage of good predictions 0.72. In the low information treatment, the number of observations is 160. The value of the log-likelihood is –105.8348 and the value of the restricted log-likelihood is -106.3476. The significance level of the c^2 is 0.5988 and the percentage of good predictions 0.62.

Summary results indicated that extended information among unions was associated to a decrease of the strike incidence due to automatic rejections. From the Probit estimation, only the first union's payoff could be taken into account. The lower this payoff, the less the strike incidence in the second negotiation, since a low payoff induces a downward revision of claims. But when unions are less informed, the knowledge of the outcome of the preceding negotiation does not significantly affect strikes, in contrast with Kuhn and Gu. While information variables are not directly relevant, the employers' reluctance against unequal shares is probably more influential a determinant of the strike incidence.

Table 6

Determinants of Unions' Payoffs (Least Squares with Group Dummy Variables and Time Effects)

	High Information		Low Information	
Variable	Coefficient	P-value	Coefficient	P-value
Constant	12.9805 (9.5612)	0.1763	20.3137 (7.8879)	0.0109
Union's belief in the first negotiation	-2.4132 (12.6834)	0.8493	…	…
Union's claim in the first negotiation	-0.1888 (0.2467)	0.4449	…	…
Union's payoff in the first negotiation	0.7252 (0.3286)	0.0286	0.1458 (0.1523)	0.3399
Strike in the first negotiation	29.0160 (19.3771)	0.1361	5.8308 (8.5938)	0.4985
Adjusted R^2	0.5872		0.5052	

Note.- Standard errors are reported in parentheses. In the high information treatment, the number of observations is 180. The value of the log-likelihood is –756.5952. The value of the restricted log-likelihood is –

854.5558. In the low information treatment, the number of observations is 160. The value of the log-likelihood is –688.0387 and the value of the restricted log-likelihood is -744.9514.

Similarly, under extended information, the second unions' payoffs are positively affected by the first ones' and, to some extent, by the occurrence of a strike in the first negotiation since it conveys a signal on the necessity to revise claims. In contrast, the same variables, when they constitute the whole information set, exert no significant influence.

Thus, in contrast with the theoretical predictions of our strike model with selfish agents, bargaining outcomes differ in the extent of the information set. Kuhn and Gu's predictions on the Pareto-improving effect of information spillovers do not stand when unions only receive information on the preceding negotiation outcome. This information is influential only when embedded in a larger set of information, even though the other pieces of information do not influence directly the outcomes but mainly help the second unions in better understanding the first bargaining outcome and thus revising their own claims. Once again, employers' behavior is possibly a better direct candidate in explaining bargaining outcomes.

V. Conclusion

It is now widely acknowledged that asymmetric information in bargaining pairs conveys an important source of conflict in wage negotiation. Consequently, whenever the uninformed party in the negotiation can improve his knowledge, it should be better off since the risk of conflicts should diminish. Information on the business climate, and thus on the capacity of the firm to pay, can be provided by the observation of preceding negotiations in other companies. Kuhn and Gu (1999) provides such a model in which two union-firm pairs bargain in sequence over the share of a pie, each firm being correlated with the other. We have proposed herein a model which replicates the same structure but differs from that of Kuhn and Gu as regards, first, a dissociation between the unions' beliefs and the distribution probability about the state of the firm and, second, the extent of the information set transferred from the first to the second union. Whereas the "low information" treatment replicates Kuhn and Gu's, the "high information" treatment endows the second union with an additional information about the first union's behavior.

Experimental evidence confirms Kuhn and Gu and our model's predictions that information spillovers and learning are a driving force of claim revision in bargaining, i.e. unions decrease their demand when learning from a conflict occurring in the preceding negotiation. This casts some doubt on Dunlop's conjecture that observing preceding negotiation outcomes lead unions to revise pathologically their claims upward, entailing an inflationary wage process. An upward revision of claims is observed only when unions are able to learn from the first unions' behavior and not only from the bargaining outcome.

However, learning is insufficient for achieving the predicted claim revision and, therefore, the predicted wage. Informational conditions have to be distinguished. Whenever unions can only learn from the first bargaining outcome, information spillovers do not significantly influence strike incidence and bargaining outcomes, thus refuting Kuhn and Gu's predictions. In contrast, whenever they are given more complete information enabling to learn from the leading unions' bargaining behavior, information spillovers lower strike incidence and Pareto-improve bargaining outcomes.

Three conclusions can be drawn from this asymmetric information experimental game. First, in the presence of fairness concerns, the opportunity to observe the bargaining outcome but not the bargaining process cannot enable a reduction in informational asymmetry sufficient to guarantee Pareto improving bargaining outcomes. Second, if one extrapolates informational structure to institutional organization, union heterogeneity challenges the potential benefits related to information spillovers, whereas union unity helps to a more profitable behavior for both parties. Third, if the pathological behavior predicted by Dunlop is not encountered in experimental data, this does not mean that emotions are absent. On the contrary, employers do reject acceptable offers. This clearly points out to the necessity to consider more actively not only asymmetric uncertainty but also both parties bargaining behavior.

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