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Spillovers and conflict in wage bargaining: Experimental evidence[☆]

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ABSTRACT

We investigate how information spillovers from other negotiations affect conflict in bargaining. Two theoretical mechanisms are studied: (1) social comparisons, which are hypothesized to increase conflict due to self-serving biases, and (2) rational learning, which is hypothesized to decrease conflict by reducing information asymmetries. Our experimental design allows for an interactive bargaining process and offers full control over the information available to negotiators. Consistent with studies of one-shot games, we find that spillovers resulting from social comparisons increase conflict; however, the bargaining process mitigates this effect. In bargaining situations in which spillovers also allow for rational learning, the conflict-increasing effects of spillovers are prevented.

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1. Introduction

Conflicts that arise during wage bargaining in firms are influenced by information about negotiations in other firms (Babcock et al. 1996; Babcock et al. 2005; Kuhn and Gu, 1999). We refer to this influence as “spillovers.” The economics literature proposes two mechanisms that explain spillovers: *social comparisons*—which stem from fairness and equity considerations (Babcock et al., 1996; Babcock et al., 2005), and *rational learning*—which results from the revelation of private information about the firm’s ability to pay (Kuhn and Gu, 1998, 1999). Social comparisons are thought to increase the level of conflict in wage bargaining whereas rational learning is thought to reduce the level of conflict.

Experimental research offers valuable insights into spillovers in bargaining (c.f. Falk and Fehr, 2003; Charness and Kuhn, 2011) because it allows the researcher to manipulate the availability of information to bargaining parties in order to isolate spillover effects.¹ Existing experimental studies predominantly model wage

bargaining as a “take-it-or-leave-it” (ultimatum) game. Such a representation does not allow negotiators to actively coordinate and, consequently, may overstate the influence of spillovers. To overcome this shortcoming we implement an experimental design that allows two subjects (a trade union negotiator and a firm negotiator) to exchange proposals; a representation which more closely mimics real world wage bargaining contexts.

Our experimental design contrasts a control condition (bargaining without spillovers) with two treatment conditions allowing for spillovers. One treatment condition provides information about the outcomes of other negotiations but does not reveal the other firm’s ability to pay (stimulating subjects to make social comparisons). The second treatment condition provides information about the outcomes of other negotiations and reveals the other firm’s ability to pay to be identical (allowing subjects to rationally learn). We study the impact of spillovers on conflict in an interactive bargaining process by analyzing: (1) trade union negotiators’ initial demands, (2) the level of divergence between trade union negotiators’ and firm negotiators’ proposals during the bargaining process, and (3) the likelihood of reaching no agreement.

2. Theory

The two theoretical mechanisms that explain spillovers in wage bargaining, social comparisons (c.f. Festinger, 1954) and rational learning (Kuhn and Gu, 1999; Burgess, 1988), both predict that demands are affected by information about (observed)

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¹ In natural data the isolation of ‘true’ influences is often problematic, due to spurious correlations and the measurement of appropriate reference points (Mitchell, 1982; Manski, 1993).

outcomes of other negotiations. However, the two mechanisms produce competing predictions about the level of conflict resulting from spillovers.

The core assumption in the social comparisons mechanism is that labor relations are affected by concerns for fairness and equity (c.f. Adams, 1963; Frank, 1984; Akerlof and Yellen, 1990; Rees, 1993). Specifically, it assumes that the preferences of negotiators (and the individuals that they represent) are influenced by the incomes and relative standings of others (e.g. Babcock et al., 2005). Consequently, the outcomes of other negotiations may become reference points for demands. Given that many other negotiations take place, all producing outcomes, a key question is which of these outcomes will be taken as a reference point (c.f. Clark and Senik, 2010). Studies show that the choice for a particular reference point is often subject to self-serving biases (Babcock et al. 1995, 1996; c.f. Rees, 1993). Hence, trade unions will formulate their wage demands on the basis of relatively high wages negotiated elsewhere, while firms will formulate their wage offers on the basis of relatively low wages negotiated elsewhere. Consequently, spillovers that arise from social comparisons will increase the level of conflict between union negotiators and firm negotiators, as reflected in their proposals.

Kuhn and Gu (1998, 1999) propose rational learning as an alternative explanatory mechanism for spillovers in wage bargaining. This mechanism is based on the assumption that the firm has private information about its ability to pay wages. Costly conflicts, such as strikes, serve as devices to reveal a firm's true ability to pay (e.g. Hayes, 1984; Kennan and Wilson, 1989; McConnell, 1989; Card, 1990; c.f. Cramton and Tracy, 2003). Kuhn and Gu (1999) furthermore assume that the abilities to pay are correlated between specific firms, for instance when they operate in the same sector and are subject to similar product market conditions and technological shocks. Kuhn and Gu (1999) develop a two-state bargaining model in which firms know their state (either "good" or "bad"), and unions know the state of a firm only with some probability. Based on this probability, a union will make either a high or a low wage demand, which a firm can either accept or reject. Low wage demands will never result in a loss for the firm. High wage demands will leave firms in a "bad" state with a loss exceeding the costs of a strike, while firms in a "good" state are better off accepting the high demand. Hence, a firm negotiator will always accept a low demand and will accept a high demand only when the firm is in a "good" state.

Kuhn and Gu (1999) show that union negotiators are able to learn by observing other negotiations. On the basis of these observations union negotiators update their prior belief that their own (similar) firm is in a "good" state and adjust their demands accordingly. A crucial, but implicit assumption of the model of Kuhn and Gu (1999: 122) is that union negotiators are strictly rational in their evaluation of reference points, meaning that they only take into account other wage bargaining events that reduce uncertainties about the state of the firm. Spillovers resulting from rational learning thus reduce the information asymmetries which cause the conflicts in wage bargaining to arise. Hence, contrary to the prediction of the social comparison mechanism, the rational learning mechanism predicts that spillover reduces the level of conflict in wage bargaining.

3. Evidence

Empirical evidence on the basis of natural data provides mixed evidence. A study of social comparisons in wage bargaining by Babcock et al. (1996) reports increasing strike probabilities with an increasing distance between negotiators' reference points—providing support for the social comparisons mechanisms. By contrast, Kuhn and Gu (1999) report decreasing strike probabili-

ties with an increasing number of observable negotiations in an industry—providing support for the rational learning mechanism.

Experimental studies provide support for the social comparisons mechanism: it is sufficient to induce spillovers (Knez and Camerer, 1995; Alewell and Nicklisch, 2009) and, in conjunction with self-serving biases, indeed increases the level of conflict (c.f. McDonald et al. 2013). Experimental studies provide less conclusive evidence about rational learning. An experimental test of Kuhn and Gu's (1999) bargaining model by Tounadre and Villeval (2004) finds limited evidence for the predicted conflict-decreasing effects of rational learning². It appears that the mechanism of social comparisons offsets the effects of rational learning. Bohnet and Zeckhauser (2004) experimentally study effects of information about the average offer in repeated ultimatum bargaining with asymmetric information and a fixed pie size. Their study suggests that social comparisons increase conflict and that social comparisons are reinforced when rational learning is possible. To our knowledge, no experimental study exists which isolates the impact of rational learning on bargaining from social comparisons³.

4. The model

We model wage bargaining as a two-player unstructured bargaining game, where the firm player has private information about the value of a common surplus that is to be divided. The union player only knows a set of possible values of the common surplus. In this way, we capture the asymmetric information between the union- and firm negotiator about the firm's ability to pay. The value of the common surplus for each negotiation is drawn randomly from a set of possible values, reflecting that the firm's ability to pay varies with economic circumstances. The union player is the first mover; (s)he makes an initial proposal that starts a time-limited bargaining process. This is analogue to the common practice of starting negotiations with union wage demands. During the bargaining process, each player can make an unlimited number of proposals or accept the other player's most recent proposal. Proposals are discrete, positive numbers with a maximum value restricted to the highest possible value of the common surplus, representing the union player's pay-off if accepted (i.e. the potential wage rate). The firm player's pay-off is determined by subtracting the accepted proposal from the value of the common surplus. Proposals that exceed the value of the common surplus, and hence leave the firm player with a loss, are possible.

If no proposal is accepted, both players receive a non-agreement payoff, which is zero points. This fall-back position is common knowledge. The non-agreement payoff may be interpreted as the cost of not reaching an agreement. In real wage bargaining, such cost would arise from strikes, lock-outs or termination of the bargaining unit. The time-limited bargaining structure reflects that wage bargaining is an interdependent concession process wherein the unions and firms try to find a mutually

² Evidence for conflict decreasing learning is found only with the introduction of additional information about the first union's beliefs about the size of the pie. Unions were otherwise unable to distinguish between outcomes in other negotiations that signal that the firm is in a bad state and outcomes resulting from a violation of social preferences.

³ It is relatively straightforward to isolate social comparisons from rational learning by studying the impact of information about outcomes of other negotiations that do not have correlated private information. However, if private information is known to be correlated, i.e. if learning is possible, it cannot be ruled out that information about other negotiation outcomes also triggers social comparisons. The impact of learning must therefore be inferred from observed difference between situations that only allow for social comparisons and situations that allow for both mechanisms to operate. Note however that this corresponds to real world bargaining situations where every potential reference point could induce spillover via social comparisons.

acceptable agreement. However, bargaining cannot continue without end, and the longer it takes for the negotiators to make a sufficient concession, the greater the probability of suffering the cost of not reaching an agreement (c.f. Roth et al. 1988: 820). The model does not allow for either player withdraw from bargaining before the deadline. This assumption is grounded in common practice: spontaneous strikes or lockouts rarely occur in most contemporary wage bargaining contexts and are often prohibited by labor law.

5. Experimental design

In our experiment, the value of the common surplus to be divided is 24 points plus a variable number of additional points, which takes any of the following possible values: $\{-12, -10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10, 12\}$ with an equal probability. Nature draws a number from the set of additional points, and only the firm player is informed about this value. The union player only knows that the common surplus is 24 points plus one of the possible number of additional points.

Bargaining takes place by making proposals representing the number of points earned by the union player if accepted. The proposals can be any whole number between 0 points and the maximally possible common surplus of $24 + 12 = 36$ points. Bargaining starts by the (uninformed) union player making an opening proposal. Once this opening proposal is made, both players can make any number of proposals, or accept the other player's most recent proposal. The history of previous proposals is visible to both players throughout the negotiation. Bargaining time is limited to 60 seconds. If a proposal is accepted, the negotiation is finished. The union player receives the number of points that the specific proposals represents. The firm player earns 24 points plus the additional number of points minus the points reflected by the proposal (i.e. the residual common surplus). If no proposal gets accepted within 60 seconds, each player receives the non-agreement pay-off of zero points. After the bargaining game, the payoff screen informs both players about their own payoffs. In each period⁴, each participant is randomly matched to another participant in the session.

In the CONTROL condition the bargaining game is played as described above. Thus the union players know the possible values of the additional points and the probability that they are realized, the firm players know the actual value of the additional points. No additional information is provided.

The two treatment conditions differ from the CONTROL condition in that they provide additional information in the form of “reference outcome” to the players. The reference outcome is an actually observed bargaining outcome of one other bargaining pair in the CONTROL treatment. The reference outcome either reports the number of points of the accepted proposal or, in case of non-agreement, that no agreement was reached⁵. The reference outcome is updated in each period. We truthfully inform the participants that the reference outcome is obtained from other participants who were subject to the same bargaining protocol.

The two treatment conditions differ in one important respect. In the UNCORRELATED treatment, the reference outcome is taken from a negotiation in which the variable number of additional points can take any of the possible values with equal probability.

In the CORRELATED treatment condition, the reference outcome is taken from a negotiation where the additional number of points is identical to that in the subjects own negotiation. The subjects are informed which situation applies via a statement, appearing on the bargaining screen just above the reference outcome. In the UNCORRELATED treatment, the statement reads: “The number of additional points in this other pair was one of the numbers $\{-12, -10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10, 12\}$, all equally likely.”. In the CORRELATED treatment, the statement reads: “The number of additional points in this other pair was EXACTLY THE SAME as it is now in your pair.”

Thus, the CONTROL condition differs from the treatments only in that there is no reference outcome presented to the players. All other information is identical. This condition therefore provides a baseline of the bargaining game with no spillovers. The UNCORRELATED treatment condition provides reference outcomes but informs the players that the variable number of points, and hence the common surplus that the other pair divided could take any of the possible values with equal probability, i.e. that it is uncorrelated to the common surplus of the players. The CORRELATED treatment condition provides reference outcomes and informs the players that the value of the common surplus that the other pair divided is identical, i.e. perfectly correlated, to the common surplus of the players. Example bargaining screen for each condition can be found in Appendix A, Figs. 1A–3A.

6. Hypotheses

6.1. The bargaining process

Regardless of the experimental condition, we expect that any bargaining process will be characterized by proposals that—in terms of their pay off to the players—will initially exceed the players' expected outcome and are revised downwards over time, reflecting the union and firm players concession curves (c.f. Hicks, 1932). Thus, union players will start by making relatively high proposals and firm players will start by making relatively low proposals. Players' proposals are, subsequently, expected to converge during the bargaining process.

Rational players would aim for proposals that maximize their pay-off but are feasible to reach agreement, avoiding the pay-off of zero points. The union player does not know the value of the common surplus, but (s)he is aware that the firm player does. While anticipating that proposals that exceed the common surplus will not be accepted by the firm, union players will use the bargaining process to assess the highest acceptable proposal, given the value of the common surplus. The firm player, on the other hand, will use the bargaining process to convince the union player to make or accept the smallest possible proposal.

However, we know that observed bargaining behavior does not conform to the predictions based exclusively on the assumptions of rationality. Rather, there is a clear tendency towards an equal division of the common surplus (c.f. Güth and Tietz, 1990; Camerer and Thaler, 1995). If that tendency holds, our bargaining game turns into a coordination problem between two players who must divide a common surplus equally, under the condition of asymmetric information about the size of the surplus. We propose that the initial salient focal point (Schelling, 1960) for the union player is a proposal of 12 points, as this represents half of the expected value of the total surplus (24). Moreover, both players will know that a proposal of 12 points reflects the highest possible proposal that never leaves the firm player with a loss.

We first develop hypotheses from the perspective that spillovers arise from social comparisons exclusively. Subsequently, we develop hypotheses from the perspective that spillovers can also arise from rational learning, provided that the common sur-

⁴ To enable a comparison of datasets across treatments, we drew a one set of variable surplus values before the first experimental session and used the same set of values in all sessions.

⁵ Reference outcomes that are non-agreements are included in order to provide a truthful and realistic presentation of the other players negotiating outcomes. We do not test specific hypotheses about the non-agreements but will control our analyses for their presence.

plus is correlated. In both cases, we first evaluate the relationship between the reference outcomes and the opening proposals in the two treatment conditions in order to establish the initial impact of spillovers, followed by hypotheses about differences in the level of conflict between all three conditions.

6.2. Social comparisons hypotheses

6.2.1. Opening proposals

The social comparison mechanism assumes that reference outcomes become salient regardless of their association with the actual total surplus. Hence, spillovers are expected to occur under both the UNCORRELATED and the CORRELATED treatment conditions.

The impact of reference outcomes through social comparisons is determined by the salience a negotiator attaches to them relative to the initial salient focal point. Taking subsequently into account that players have a self-serving bias, we may well assume that the salience of the reference outcome depends on its favorability to the player. For union players, reference outcomes lower than 12 points are always unfavorable compared to the initial salient focal point, while reference outcomes exceeding 12 points become increasingly favorable. We expect that the presence of a favorable reference outcome induces a frame switch from the initial focal point (12 points) to the value of the reference outcome. Hence, we expect the value of the reference outcomes to positively affect trade union negotiators' opening proposals, but only for reference outcomes with a value larger than 12.

Hypothesis 1. In the UNCORRELATED and CORRELATED treatment conditions, higher values of the reference outcome are associated with higher values of the union player's opening proposals. This positive association only exists for values of the reference outcome exceeding 12 points.

6.2.2. Conflict in bargaining

In the UNCORRELATED treatment condition, reference outcomes have no bearing on value of the common surplus and spillovers can only result from social comparisons. Due to self-serving biases, union players increase their demands in presence of high reference outcomes but ignore low reference outcomes. Reverse, firm players will attach salience to relatively low reference outcomes in order to exploit their presence to achieve agreements that are more favorable to them, while not responding to relatively high and therefore unfavorable reference outcomes. As a result, the self-serving biases of both players results in a divergence in proposals between the two players. Hence, the level of conflict in the UNCORRELATED treatment condition will be higher than that in the CONTROL condition—indicated by the difference between their proposals. In addition, the probability of non-agreement will also be higher because higher divergence will make it more difficult to find a mutually acceptable proposal before the deadline.

Hypothesis 2a. The divergence in proposals is higher for negotiations in the UNCORRELATED treatment condition than in the CONTROL condition.

Hypothesis 2b. The probability of non-agreement is higher for negotiations in the UNCORRELATED treatment condition than in the CONTROL condition.

6.3. Rational learning hypotheses

6.3.1. Opening proposals

Contrary to social comparisons, rational learning will only take place when the reference outcome is correlated with the true value of the common surplus and the players are aware of this. In the

UNCORRELATED treatment condition, the common surplus in the negotiation yielding the reference outcome is not known to the players and can be any even value between 12 and 36 with equal probability.

By contrast, in the CORRELATED treatment condition the correlation of firm states is perfect and this is common knowledge. Thus, the union player may rationally learn about the feasibility of the proposals in this treatment condition. We assume that the union player holds the belief that firm players will never make or accept a proposal exceeding the value of the common surplus (leaving the firm with a loss)⁶. When firm states are perfectly correlated, the reference outcome reveals the minimum value of the common surplus. In the extreme case of an accepted proposal of 36 points, the common surplus is revealed to be 36. For lower reference outcomes, the common surplus is revealed to be in the range between the reference outcome and 36.

If union players expect that the players in other negotiations behave strictly rational, they cannot improve their information about the common surplus with reference outcomes smaller than or equal to 12 points (the smallest possible value of the common surplus). However, we already noted that players use fairness considerations as a heuristic in bargaining, anticipating that negotiations will move towards outcomes that represent an approximately equal division of the common surplus. In this case, union players will interpret the reference outcome as representing approximately half of the total surplus and condition their proposals on this information. Consequently all reference outcomes in the CORRELATED treatment condition are evaluated by the union player as being relevant for ascertaining the common surplus⁷. As a result, the value of the reference outcome should be linearly related to the union player's opening proposals. This leads to the following hypothesis:

Hypothesis 3. In the CORRELATED treatment condition, higher values of the reference outcome are associated with higher values of the union player's opening proposal—over the whole range of observed reference outcome values.

6.3.2. Conflict in bargaining

With the introduction of reference outcomes that reveal information about the state of the firm (in the CORRELATED treatment condition), the information asymmetry between the two players is reduced. This has consequences for the level of conflict in bargaining. Players now know that the reference outcomes hold information about the common surplus, and they know that the other player knows this. Rather than either side attaching salience to "irrelevant" reference outcomes in a self-serving fashion, as expected to occur in the UNCORRELATED treatment condition, rational learning implies that the salience of the reference outcomes is dictated by their relevance to the common surplus. Thus union players' proposals will increase with increasing reference outcomes but increasing reference outcomes themselves are associated with a higher actual values of the common surplus. Moreover, union players are expected to moderate their proposals in the presence low, unfavorable reference outcomes. For firm players, it will be more difficult to selectively ignore high reference outcomes and hide behind proposals that are far below the equal split of the common surplus. This is a consequence of the union players' knowledge of

⁶ This assumption is supported by our experimental findings. Out of 403 observed accepted proposals, only three exceeded the value of the surplus.

⁷ Reference outcomes that are lower than half of the lowest possible total surplus (<6) would reveal 'greedy' firm players but may still be indicative of low surplus values if union players expect limited greed. This situation was rare in our experiment, with only 4.7% of the negotiations in the CORRELATED and UNCORRELATED treatments receiving a reference outcomes that took the lowest observed value of 5 points.

the correlation between the reference outcome and the value of the common surplus. Compared to the UNCORRELATED treatment condition, self-serving biases are less likely to occur in both players in the CORRELATED treatment condition and we therefore expect less conflict in the latter condition⁸.

Hypothesis 4a. The divergence in proposals is lower for negotiations in the CORRELATED treatment condition than in the UNCORRELATED treatment condition.

Hypothesis 4b. The probability of non-agreement is lower for negotiations in the CORRELATED treatment condition than in the UNCORRELATED treatment condition.

7. Procedure

We collected our data in October 2012 in the NSM Decision Lab at Radboud University Nijmegen, The Netherlands. The experiment was programmed and implemented in a computerized environment using “z-Tree” (Fishbacher, 2007). A total of 70 students participated in the experiments, none participating in more than one session. Each session lasted approximately 1.5 hours, excluding the payment of the participants, yielding 14 periods of interaction that will be analyzed in this paper⁹.

Upon entering the laboratory, each participant was randomly assigned to a computer cubicle. The computer program assigned half of the participants in a session to the role of the firm (referred to as PLAYER A in the experiment) and half to the role of union (referred to as PLAYER B in the experiment). In the first session, the CONTROL condition was implemented, in the following sessions the computer program assigned each participant to either the CORRELATED treatment condition or the UNCORRELATED treatment condition. Participants remained in the same role and condition throughout. After each period, the participants were randomly rematched to a different opponent. We collected data on 20 participants in the CONTROL condition, 26 participants in the CORRELATED treatment condition and 24 participants in the UNCORRELATED treatment condition.

Participants earned points during the experiment. The exchange rate for these points was 1 point=6 Euro cents. On average, the participants earned 13.88 Euro ($\sigma=1.56$) in the experiment, including the show-up fee of three Euro¹⁰.

Written instructions for the main experiment were read aloud by one of the experimenters. All of the participants' questions were subsequently answered privately by the experimenters. The participants were then asked to answer a set of test questions to ensure that every participant fully understood the rules of the game and the payoff structure. All participants passed this test without difficulty. The experiment subsequently began with two unpaid trial periods. All experiment participants were paid their earnings in cash immediately after the experiment.

⁸ Note that if spillovers would only result from rational learning, conflict should also be lower in the CORRELATED treatment condition than in the CONTROL condition due to the reduced information asymmetry. In this case, reference outcomes would not affect bargaining in the UNCORRELATED treatment condition at all because there exists no opportunities for learning. Given the well documented effects of social comparisons in previous studies, we do not here formulate these specific hypotheses.

⁹ The players interacted for 15 periods, but due to a software glitch, the variable surplus in the final period of interaction (period 15) did not take the correct value in the CONTROL treatment. As this would eradicate the perfect correlation between the surplus in the reference outcome and the actual surplus in the CORRELATED treatment, we decided not to include the data from this final period in our analyses.

¹⁰ The payment also includes small fee for a pen-and-paper pre-experiment unrelated to this study, distributed in all treatments. This pre-experiment lasted a few minutes, and subjects received no feedback about its outcomes before participating in the bargaining game in order to avoid any cross-effects.

8. Experimental evidence

In this section, we first present a graphic representation of the bargaining process for the control condition and the two treatment conditions. Subsequently, we provide a more detailed analysis of the impact of spillovers on the bargaining process, starting with an analysis of the opening proposals, followed by an analysis of the divergence in proposals during bargaining, and the probability that non-agreement occurs. Because the values of the common surplus, and reference outcomes vary across individual negotiations within the treatments, an aggregate analysis would produce biased results. Therefore we introduce multivariate analyses that control for these variations, as well as for potential biases arising from repeated observations within participants. An overview of definitions of the variables used in the multivariate analyses is provided in Appendix B, Table B1. Also provided in Appendix B are descriptive statistics on these variables at the negotiation-level (Table B2) and at the proposal-level (Table B3).

8.1. The bargaining process: an illustration

Fig. 1 summarizes all observed union and firm player proposals ($N=5635$) during the 60-second bargaining time in the experimental conditions. For each condition two (loess regression) lines are drawn: one representing the union player's proposals (as expected with a high average starting value and downward slope) and another representing the firm player's proposals (as expected with a low average starting value and an upward slope). Fig. 1 clearly shows that, in all three conditions, the union player's and firm player's proposals converge during the bargaining process. This supports our behavioral assumption that players will converge during bargaining. Fig. 1 also provides some first, preliminary insights into our theoretical expectations. In the first place, we observe the evolution of union and firm players' proposals is virtually identical in the CORRELATED and CONTROL condition. In the UNCORRELATED treatment condition, union proposals are noticeably higher early in the bargaining process, resulting in a higher level of divergence. However, the rate at which union proposals decrease and hence at which proposals converge is also higher, resulting in increasingly similar levels of divergence in the three conditions as the deadline approaches. On the aggregate then, social comparisons in isolation appear to increase initial conflict, but the bargaining process mitigates this effect.

8.2. Multivariate analyses

8.2.1. Opening proposals

Opening proposals are limited to a maximum of 36 points and this value is disproportionately often chosen¹¹. We fit tobit regression models taking into account this censoring, with a subject specific random effect for each union player to control for unobserved heterogeneity. The period of interaction is also controlled by including a continuous period-effect in each model.

The results are presented in Table 1. Models 1a and 1b estimate the linear effects of the value of the reference outcomes on the opening proposals in respectively the UNCORRELATED and CORRELATED treatment condition. For non-agreement reference outcome, this variable is set to zero. A dummy variable for these non-agreements is included in all models to control for their potentially

¹¹ The results presented here were subject to extensive robustness checks using alternative model specification, e.g. estimating linear models instead of tobit models for the opening proposals, including subject-specific fixed (rather than random) effects, including a full set of period dummies instead of estimating a linear period-effect, using different parameterizations for the non-linear effect of the reference outcomes, and sensitivity analyses regarding potential multicollinearity. Our findings proved to be robust. These checks are available from the authors upon request.

Fig. 1. Union and firm player proposals over time, loess regression lines.

Table 1
Tobit regression estimates of the effects of spillovers on the opening proposals.

Model	UNCORRELATED		CORRELATED	
	1a	2a	1b	2b
Fixed effects	b	b	b	b
Intercept	25.724*** (2.397)	30.812*** (2.710)	16.731*** (2.346)	17.989** (2.953)
Period	0.113 (0.085)	0.104 (0.080)	0.374*** (0.086)	0.374*** (0.087)
Reference outcome = no agreement (dummy)	0.287 (1.383)	-4.696* (1.891)	2.643 (1.487)	1.401 (2.301)
Reference outcome	0.014 (0.099)	-0.566** (0.191)	0.293** (0.106)	0.147 (0.228)
Reference outcome > 12 (dummy)		-21.682*** (5.728)		-0.375 (6.201)
Interaction				
Reference outcome* Reference outcome > 12 (dummy)		1.612*** (0.380)		0.105 (0.419)
Wald χ^2 (df)	1.8(3)	21.61(5)***	25.39(3)***	26.05(5)***
Log likelihood	-465.369	-456.124	-510.327	-510.037
N		168		182
N right-censored		19		23

Estimated random effects are omitted from the table, full estimates in Appendix B4. Standard errors in parentheses.

Two-tailed; only reported for fixed effects (z-test).

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

differential impact. For Models 2a and 2b, a dummy indicating that the reference outcome exceeds 12 points and its product with the value of the reference outcome are added. In this way, the effect of the reference outcome is conditioned on its position vis-à-vis the hypothesized initial focal point of 12 points, allowing us to test whether the effect of the reference outcome changes when reference outcomes exceed 12 points.

Hypotheses 1 predicts that in both treatment conditions, higher reference outcomes are associated with higher opening proposals, but only when the reference outcome exceeds 12 points. In the UNCORRELATED treatment conditions, there is no significant linear effect of the reference outcomes (model 1a). However, model 2a

shows that there is in fact a non-linear, V-shaped effect¹², showing that union players significantly increase their opening proposals the more the reference outcomes deviate in either direction from the hypothesized initial focal point of 12 points. In line with hypotheses 1, reference outcomes thus lead to higher opening proposals only once they exceed 12 points. However, while no effect was expected when for reference outcomes < 12 under **Hypothesis 1**, we find significant negative effect, with increasingly low reference outcomes associated with increasingly high opening proposals. No such non-linear effect is found in the CORRELATED treatment condition. Here, a significant linear effect is found (model 1b), but there is no evidence that this effect changes when reference outcomes fall below 12 points (model 2b)¹³. This supports **Hypothesis 3**, which states that in the CORRELATED treatment condition the reference outcome value is linearly related with the opening proposals over the whole range of observed outcome values. In this condition, every increase in the reference outcome increases the predicted opening proposal.

8.2.2. Divergence

Divergence is measure by subtracting the current firm proposal from the current union proposal for every proposal made in a negotiation by either player. The resulting value is the difference between union demands and firm offers for every given proposal. The variable measuring divergence is not afflicted by censoring, allowing us to fit linear models. However, each negotiation can have multiple observations (on average 10.8) and is nested within the randomly re-matched union and firm players. The data structure is thus observed divergences nested in negotiations, which are cross-classified in players. Random effects were estimated in order to account for this data structure. All models include control variables for the period of interaction, the value of the variable surplus and

¹² The addition of the > 12 dummy and its interaction improves model fit in the UNCORRELATED treatment (LR $\chi^2 = 18.49$; $p = 0.0001$). The effect of the reference outcomes when they are ≤ 12 is given by the b of the main effect (-0.566), as the >12 dummy and the interaction term are necessarily 0 in this case. For reference outcomes > 12, the effect is given by adding the b's of the main effect and the interaction effect (-0.566+1.612=1.046), as the >12 dummy is 1 in this case, therefore the interaction term is 1.612*1, and the dummy variable itself allows for a shift in the intercept for the cases with reference outcomes > 12.

¹³ The addition of the > 12 dummy and its interaction does not improve model fit (LR $\chi^2 = 0.58$; $p = 0.7486$).

Table 2

Linear regression estimates of the effects of spillovers on the divergence between union and firm proposals during bargaining.

Model	All	UNCORRELATED	CORRELATED
Fixed effects	1	2	3
	b	B	b
Intercept	18.706*** (1.705)	28.733*** (2.452)	14.435*** (1.823)
Time (seconds)	-0.312*** (0.006)	-0.409*** (0.026)	-0.257*** (0.018)
Period	0.082* (0.041)	-0.046 (0.076)	0.212** (0.067)
Variable surplus	-0.147*** (0.021)	-0.145*** (0.040)	-0.134*** (0.038)
Treatment (dummy)			
CONTROL	Reference		
CORRELATED	-0.292 (2.229)		
UNCORRELATED	5.107* (2.269)		
Interaction			
Time*CORRELATED	0.005 (0.007)		
Time*UNCORRELATED	-0.044*** (0.007)		
Reference outcome = no agreement (dummy)		-2.523 (1.939)	3.341* (1.324)
Reference outcome		-0.476* (0.198)	0.309** (0.097)
Reference outcome > 12 (dummy)		-7.694 (5.889)	
Interactions			
Reference outcome*Reference outcome > 12 (dummy)		0.634 (0.391)	
Time*Reference outcome = no agreement (dummy)		0.033 (0.028)	-0.058** (0.020)
Time*Reference outcome		0.006* (0.003)	-0.006*** (0.001)
Time*Reference outcome > 12 (dummy)		0.204* (0.097)	
Time*Reference outcome*Reference outcome > 12 (dummy)		-0.016* (0.006)	
Wald χ^2 (df)	13,999.83(7)***	5922.81(11)***	4671.59(7)***
Log likelihood	-14,362.752	-5134.062	-5425.785
N observations	5232	1869	1969
N negotiations	484	166	180

Estimated random effects are omitted from the table, full estimates in Appendix B5. Standard errors in parentheses.

Two-tailed; only reported for fixed effects (z-test).

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

the time within the 60-second bargaining process at which Divergence was observed.

In Table 2, three models are presented that analyze the level of divergence throughout the bargaining process. By including time as an independent variable, the timing of the observed divergences in the bargaining process is controlled for. The (negative) coefficient of this variable captures the decrease in divergence during the bargaining process, i.e. the rate of convergence per second. Model 1 pools all treatments and includes treatment dummies and their interaction with time. In this way, the initial differences in divergence between the conditions are estimated, given by adding the

coefficients of the treatment dummies to the intercept. The rate of convergence in each condition is also estimated, given by adding the coefficients of time to the coefficient of the respective interaction term. The (nonlinear) impact of the value of the reference outcomes on divergence during the bargaining process is estimated for the UNCORRELATED treatment condition in Model 2, while Model 3 estimates their (linear) impact in the CORRELATED treatment condition¹⁴.

Divergence is, at least initially, higher in the UNCORRELATED treatment condition than in the CONTROL condition, supporting Hypothesis 2a. It is also higher in the UNCORRELATED treatment condition than in the CORRELATED treatment condition, as predicted under Hypothesis 4a. However, the rate of convergence is also significantly higher in the UNCORRELATED treatment condition than in the other two conditions.

At values ≤ 12 points, decreasing reference outcome values lead to increasing divergence in the UNCORRELATED treatment condition. During the bargaining process, this increase in divergence is mitigated. For reference outcomes > 12 , there is no significant effect¹⁵. In the CORRELATED treatment condition, divergence linearly increases (decreases) with higher (lower) reference outcomes. Here too, the effect is mediated during the bargaining process. Fig. 2 illustrates the marginal effects and the associated 95% confidence intervals of the value of the reference outcomes on divergence during the bargaining process, taking into account all interaction effects. The upper graph shows the marginal effect in the CORRELATED treatment condition, which starts out positive but decreases over bargaining time and becomes insignificant later in the bargaining process. The lower graph shows the marginal effects for reference outcomes ≤ 12 (dashed line) and for reference outcomes > 12 (tight dotted line). The former starts out negative but increases toward zero over bargaining time and becomes insignificant later in the bargaining process, the latter never reaches significance.

8.2.3. Non-agreements and agreements

Non-agreements are analyzed using logistic regression models, presented in Table 3. All models incorporate crossed subject specific random effects and control for period of interaction and the value of the variable surplus. In model 1, all conditions are pooled and differences in the probability of non-agreement between the conditions are estimated by including dummy variables for the CONTROL condition and the CORRELATED treatment condition, with the UNCORRELATED treatment condition serving as the reference category¹⁶. The effect of the reference outcome value on the probability of non-agreements is estimated for the CORRELATED treatment condition in model 2 and the UNCORRELATED treatment condition model 3. This effect is modeled, following the functional form established in the previous analyses, with a linear effect in model 2 and non-linear effect that changes at 12 points in model 3.

There estimates for the CONTROL and CORRELATED dummies in model 1 are not significant, indicating that there are no differences in the probability of non-agreement between the UNCORRELATED treatment condition and the other two conditions. This refutes Hypothesis 2b and Hypothesis 4b, which predict a higher probability of non-agreement in the UNCORRELATED treat-

¹⁴ Additional analyses confirmed that these are the appropriate specifications. Both models were estimated for both treatments and the three-way interaction in Model 2 was omitted in favour of separate estimations for reference outcomes ≤ 12 and > 12 in the UNCORRELATED treatment.

¹⁵ Additional analyses show that divergence is however also higher in the UNCORRELATED treatment than in the CORRELATED treatment for reference outcomes > 12 .

¹⁶ By using this reference category, we can test hypotheses 2b and 4b directly with the z-tests of the dummy coefficients.

Fig. 2. Marginal effect of reference outcome on divergence (95% CI).

ment condition than in the CONTROL condition and the CORRELATED treatment condition, respectively. Model 2 and model 3 show that the value of the reference outcome does not significantly affect the occurrence of non-agreements in either of the treatment conditions¹⁷.

We also estimated the impact of the reference outcome value on the agreements, i.e. the value of the accepted proposals (Appendix Table B4), in both treatments testing for a linear effect as well as a non-linear effect that changes when reference outcomes exceed 12 points. The findings show that accepted proposals linearly increase with the value of the reference outcome in the CORRELATED treatment condition. In the UNCORRELATED treatment, accepted proposals also increase with the value of the reference outcome but only when it exceeds 12 points, whereas there is no

Table 3

Logistic regression estimates of the effects of spillovers on non-agreement probabilities.

	ALL	CORRELATED	UNCORRELATED
Model	1	2	3
Fixed Effects	b	B	b
Intercept	-1.046** (0.349)	-1.274 (1.028)	-1.442* (1.248)
Period	-0.077* (0.032)	-0.074 (0.054)	-0.050 (0.055)
Variable surplus	-0.104*** (0.018)	-0.098** (0.033)	-0.151*** (0.036)
Treatment			
CONTROL	0.011 (0.399)		
CORRELATED	-0.292 (0.382)		
UNCORRELATED	Reference		
Reference outcome = no agreement (dummy)		-0.410 (1.001)	-0.128 (1.239)
Reference outcome		-0.006 (0.079)	0.016 (0.127)
Reference outcome > 12 (dummy)			-8.320
Interaction			
Reference outcome*Reference outcome > 12 (dummy)			0.490 (0.278)
Wald χ^2 (df)	35.88 (4)***	11.18(4)**	18.24(6)**
Log likelihood	-206.306	-71.436	-68.520
N	490	182	168

Estimated random effects are omitted from the table, full estimates in Appendix B6.

^blogit estimate, standard error in parentheses.

Two-tailed; only reported for fixed effects (z-test).

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

significant relationship with the accepted proposals when the reference outcomes are below 12 points.

9. Conclusion

We set out to investigate how information about other negotiations influences conflict in bargaining under conditions that only allow for social comparisons and conditions that also allow for rational learning. Six hypotheses were tested with the aid of a bargaining experiment. An overview of our findings is presented in Table 4.

The social comparisons mechanism is sufficient to induce spillovers. These result in increased levels of conflict as measured by the divergence of union and firm proposals compared to bargaining without spillovers. However, the nature of spillovers changes when rational learning is possible, such that conflicts resulting from social comparisons and self-serving biases are prevented. Learning itself is facilitated by the union's anticipation of the impact of equity and fairness on observed outcomes in other negotiations, which are interpreted as equal splits.

When learning is possible, union demands and the level of conflict decrease with lower reference outcomes. However, when spillovers result from social comparisons exclusively, increasingly low and unfavorable (i.e. below the initial salient focal point) reference outcomes lead to higher union demands and more divergence. This latter finding may be attributable to unions' escalating their demands when confronted with reference outcomes that are increasingly unfavorable to them, but fundamentally irrelevant to the firm's ability to pay, in an effort to prevent the poten-

¹⁷ Additional analyses revealed that the average level of divergence in a negotiation significantly increases the probability of non-agreement in all three conditions.

Table 4
Summary of findings.

Hypothesis		Findings
1	In the UNCORRELATED and CORRELATED treatment conditions, higher values of the reference outcome are associated with higher values of the union player's opening proposals. This positive association only exists for values of the reference outcome exceeding 12 points.	Partially supported for the UNCORRELATED treatment condition (the effect changes direction below 12)
2a	The divergence in proposals is higher for negotiations in the UNCORRELATED treatment condition than in the CONTROL condition.	
2b	The probability of non-agreement is higher for negotiations in the UNCORRELATED treatment condition than in the CONTROL condition.	Refuted
3	In the CORRELATED treatment condition, higher values of the reference outcome are associated with higher values of the union player's opening proposal—over the whole range of observed reference outcome values.	Supported
4a	The divergence in proposals is lower for negotiations in the CORRELATED treatment condition than in the UNCORRELATED treatment condition.	Supported
4b	The probability of non-agreement is lower for negotiations in the CORRELATED treatment condition than in the UNCORRELATED treatment condition.	Refuted

tial self-serving exploitation of such reference outcomes by the firm.

As a caveat to the interpretation of studies relying on one-shot games, our findings suggest that the impact of spillovers on conflict is strongly mitigated when negotiators are allowed to interactively bargain. However, higher reference outcomes do translate into higher eventually accepted proposals, both when learning is possible and when spillovers result from social comparisons. In the latter case, this effect only holds for reference outcomes that are favorable to the union compared to the initial salient reference point.

Previous studies of the impact of spillover on conflict in wage bargaining yielded conflicting results. A potential explanation is that social comparisons and rational learning are theoretically and empirically intertwined. Spillovers do not only occur when they provide information relevant to firms' ability to pay. Comparisons matter and can lead to conflicts. Where opportunities for learning are relatively abundant however, conflicting interpretations of reference outcomes may be reduced. Finding conflict-decreasing spillovers could consequently result from the mitigation of social comparisons rather than being indicative conflict-decreasing effects in their own right.

One might argue that learning does not take place at all and conflict reduction simply results from increasing the salience of potential reference points for social comparisons. However, in our design, this increase in salience would be due to informing the players of the identical surplus value, i.e. making learning possible. This raises the question if salience can be boosted for similar effect without creating possibilities for learning, a question future research should address. Moreover, our study raises the question if and how the relative impact of social comparisons effects and rational learning could be varied when both mechanisms can operate. Furthermore, additional treatments may be explored incorporating reference outcomes from negotiations with unknown range and probability of common surplus values of the other pair, or with information about the exact common surplus value of the other pair.

Another potential extension of this research is the incorporation of spillovers that reveal information about the costs and benefits of conflict (Lehr et al., 2015a) by modeling correlation between the outside options in different bargaining units. Empirical research using natural data may benefit from recognizing that average effects may capture different and potentially counteracting spillover effects. Survey data of negotiators may help to systematically identify salient reference points (e.g. Babcock et al. 1996; Bewley, 1999; Lehr et al., 2015b).

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi: [10.1016/j.socsc.2016.05.002](https://doi.org/10.1016/j.socsc.2016.05.002).

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