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Bargaining and strikes: Towards an evolutionary framework

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Abstract

Conventional models of strikes start with the assumption that the bargainers' uniquely rational beliefs can be worked out in advance. Strikes are then explained as either the result of institutional constraints or of the possibility of irrationality. By contrast the evolutionary approach begins with a recognition that bargaining is naturally indeterminate and that, in the absence of a unique model of rational bargaining, conflict-free agreements between rational trades unions and firms reflect the evolution of one out of many possible conventions. This paper explores the alternative interpretation of strikes afforded by this perspective. In particular, it shows how strikes help shape the dispositions of bargainers (as opposed to just revealing it), how periods of conflict are succeeded by periods of industrial peace (and vice versa), and how the stability of bargaining protocols depends not only on the conventions regulating the relations between unions and firms but also on those between workers and union leaders as well as on technological innovations.

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1. Introduction

In any analysis of rational bargaining between trades unions and firms, industrial conflict must be explained as the result of some informational deficiency. For if the two sides knew in advance the outcome, their rationality ought to instruct

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them to settle in accordance with the foreseen outcome without incurring the cost of fighting. There is nothing controversial in this. However, the seeds of controversy take root at the next level of abstraction when it is *assumed* that bargaining problems have uniquely rational solutions to be deduced logically.

The starting point of this paper is a recognition that a complete range of rational bargaining strategies cannot be specified in advance even under perfect information about objective functions. [1] Unlike the conventional literature which seeks out equilibrium bargaining strategies after axiomatically imposing on firms and unions conjectures that are consistently aligned, we suggest an alternative evolutionary approach. The objective is to explore the evolution of conventions which lead bargainers to aligned beliefs and, ultimately, to bargaining agreements.

As the above suggests, mainstream theory thinks of settlements between trades unions and firms as the realisation of uniquely rational strategies, and of the prospect of conflict (eg. strikes, lockouts etc.) as the provider of information about the objectives and constraints of each other. [2] In this sense, the possibility of industrial conflict aids the *revelation* of the firm's and union's bargaining dispositions. Nevertheless, actual strikes cannot be accounted for unless they are blamed on some institutional constraint or on irrationality. [3] By contrast, our evolutionary approach sees automatic settlements as evidence that one out of many equally rational conventions has become established, and of conflict as both a byproduct of the process of convergence to a convention and as a symptom of the mutations which periodically threaten every such convention. In this context, industrial conflict plays a significant role in the *creation* of the bargainers' dispositions.

Section 2 establishes the notion of bargaining strategies as the products of evolution. Section 3 then illustrates the new insights made possible by an evolutionary approach. In particular it suggests a new interpretation of strikes as experiments with alternative evolutionary protocols and illustrates how periodic waves of strike activity may be due to rational tests of the evolutionary stability of the status quo as well as to the separate conventions regulating the relationship between trades unions and their constituents. Finally Section 4 concludes.

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[1] Sugden (1990) argues that bargaining theory can pinpoint uniquely rational solutions to the bargaining problem only if it assumes that such solutions exist. However he claims that this assumption (which he refers to as *Rational Determinacy*) is analytically indefensible. See also Varoufakis (1991, Ch. 5) for a similar critique of subgame perfect bargaining solutions with particular reference to the conventional literature on strikes.

[2] For example see Hayes (1984), Hart (1989), Kennan and Wilson (1989), McConnell (1989) and Mailath and Postlewaite (1990).

[3] For example, unless bargainers are prevented from exchanging offers or demands at will [e.g. if there is a minimum delay between offers as in Rubinstein, 1985, or one has the capacity to shut down channels of communication after issuing a demand as in Admati and Perry (1987)], optimal strike duration tends to zero. Then irrationality is the only explanation of why strikes occur.

2. Evolving bargaining strategies

Suppose a trades union (U) and a firm (F) have access to a history of H negotiations. This history can be thought of as a database or matrix with each of the H rows representing one negotiation while the columns of this matrix correspond to each bargaining round. Of the H rows (or negotiations), h rows involved the same U and F pair whereas the remaining $H-h$ relate the history of negotiations between other firms and unions in the industry or related industries. Each column contains a pair of demands (one for F the other for U) for each round of the negotiation. These pairs of U and F demands are expressed in terms of portions of the surplus to be distributed between capital and labour [4] which is normalised to equal 1 for convenience; i.e. $(x, y)_{it}$. If in negotiation i agreement was reached at, say, $t=2$ then the entries for columns $t>2$ are left empty.

To summarise, each negotiation is remembered by a string of demands

$$<(x_1, y_1),(x_2, y_2),\ldots,(x_\tau, y_\tau)>_i \quad \text{s.t. } x_\tau = 1 - y_\tau,$$

implying that agreement was reached in round τ; i.e. $x_\tau = 1 - y_\tau$. A negotiation i characterised by $\tau = 1$ is one which achieved agreement without a strike. Thus if $i \in H$, where H is the set of all previous negotiations, and C is the subset of H whose elements involve instances of industrial conflict, then $\tau > 1$ for all $i \in C$.

Imagine that the current negotiation is in round t. Of the H available observations, F samples m_F past negotiations which had also reached round t. Letting k_F be the number of observations out of m_F in which U accepted, during t, an offer equal to or less than $1 - x_t$, then F's empirical cumulative distribution function of the probability that the union will accept $1 - x_t$ is $G(1 - x_t) = k_F/m_F$. If the union accepts this offer, then F's payoffs in round t equal $U^F(x_t)$; otherwise it incurs the cost of an extra round of delay in reaching agreement, say c_F. For simplicity we assume that these conflict costs are constant, i.e. $c_F(t) = c_F(t-1)$. Hence F's per round optimal demand is given by (1):

$$x_{it}^* = \text{argmax}\left[U^F(x_{it}) + c_F\right](k_F/m_F). \tag{1}$$

A similar description of U's optimisation problem yields its optimal demand per round per negotiation as (2) below:

$$y_{it}^* = \text{argmax}\left[U^U(y_{it}) + c_U\right](k_U/m_U). \tag{2}$$

Therefore observed strike duration τ in each negotiation is the minimum value of t which gives rise to (3):

$$\text{argmax}\left[U^F(x_{it}) + c_F\right](k_F/m_F) - \text{argmax}\left[U^U(y_{it}) + c_U\right](k_U/m_U) = 0. \tag{3}$$

[4] The surplus over which F and U bargain equals the firm's total revenue minus non-labour costs.

At this stage it is worth noting the difference between an equilibrium and an evolutionary approach. The former tradition treats the probability of disagreement in each stage as a set of subjective beliefs of F and U to be worked out in a way such that (a) they are consistently aligned (or common knowledge) inter-temporally and (b) they are consistent with (1) and (2) above. For this to be possible, the implicit assumption is made that such a uniquely rational set of beliefs exists; Sugden (1990) calls this the axiom of *rational determinacy*. By contrast, the evolutionary approach has agents accepting the impossibility of such an a priori coincidence of beliefs. Once they recognise the plausibility of many alternative subjective beliefs about each other, they look to past experience for a guide to the negotiation in hand. Notice that this is not to say that they opt for adaptive learning because they are less than rational; it is rather that rationality cannot pick out the 'right' beliefs and therefore bargainers' only real option is to blunder around for clues, acting as sensibly as they can.

Perhaps the most striking difference between the evolutionary and the conventional equilibrium approach is that the former attempts to generate endogenously the equilibrating mechanism whereas the latter imposes it axiomatically. The fact that the conventional literature has only provided a thin explanation of rational strikes is no more than a natural reflection of the methodological move to *assume*, as opposed to *generate*, equilibration of beliefs. Once beliefs are assumed to be in alignment, it is unsurprising that the only explanation of failing to avert costly disagreement (even under asymmetrically distributed information) is either some exogenous impediment to settling quickly or irrationality – see note 3. The promise of the evolutionary approach is that strikes can be suddenly admitted as the result of rational behaviour by agents who are searching for a way to equilibrate their beliefs.

To offer an idea of how this equilibration can occur endogenously, consider a strike which has been going on for t rounds already. What offer should F and U make at $t+1$? Judging from (1) and (2), it seems that the answer depends on the number of times in the past that particular offers under consideration were accepted by the opposite side divided by the number of negotiations that also lasted $t+1$ rounds. However, notice that the longer the strike the fewer the observations m_F and m_U which are left into the sample. So, if bargainers were to base their estimate of the cumulative probability distribution function of having an offer rejected at $t+1$ solely on the empirical equivalent (i.e. on the ratios k_j/m_j, $j = U, F$) they would effectively be rejecting valuable information. For example, suppose that in round $t+1$ U is looking at a previous negotiation which was settled in round t with F accepting U's demand of, say, y'. That negotiation never reached round $t+1$. Does this mean that it should drop out of U's current sample? Does it not contain useful information on whether F may accept U's demand for y' at $t+1$?

However, if this observation of what happened is admitted in the sample, it will increase m_U and k_U by one, effectively increasing the estimated probability that

an offer to F at time $t+1$ of $1-y'$ will be accepted. While it is difficult to argue that U should not change its prediction that F will accept $1-y'$ in this way (since the fact that $1-y'$ was accepted in a previous negotiation in a similar, albeit earlier, round carries interesting information), on the other hand such an alteration of the available sample is largely arbitrary: U does not have any firm indication of how F would have behaved in round $t+1$ of the previous negotiation since that round was never reached. Whether a bargaining side will proceed with this alteration or not (and in the absence of a uniquely rational bargaining strategy), is a matter of *disposition*. Some unions or firms may admit this type of deduction in their information set, whereas others will not.

Let d_t^F and d_t^U denote the two sides' dispositions in this regard defined as the number of previous negotiations which will be sampled in order to gauge what will happen in the next round (i.e. $t+1$) even though they were settled in some round $t' < t+1$. Thus the optimal offers in (1) and (2) become:

$$x_{it}^* = \operatorname{argmax}\left[U^F(x_{it}) + c_F\right]\left[\left(k_F + d_t^F\right)/\left(m_F + d_t^F\right)\right], \tag{4}$$

$$y_{it}^* = \operatorname{argmax}\left[U^U(y_{it}) + c_U\right]\left[\left(k_U + d_t^U\right)/\left(m_U + d_t^U\right)\right]. \tag{5}$$

Expressions (4) and (5) give the evolutionary bargaining process its foothold. Since the parties' dispositions are arbitrary, it is they that must evolve through time in response to aggregate behaviour. Letting $D^U \times D^F$ be the set of all possible dispositions, we think of $\rho_{it}(d^U, d^F)$ as the probability that during round t of negotiation i the set of dispositions (d^U, d^F) will be selected by the two sides out of set ${}^{D}U \times D^F$. The question then becomes: how will these dispositions evolve?

Given an history $h < H$ between F and U and a particular set of dispositions, in each round of the current negotiation (4) and (5) translate into each negotiating team's optimal mixed bargaining strategies:

$q_F(x|d^F, h)$: conditional probability that F offers U $1-x$ given history H,

$q_U(y|d^U, h)$: conditional probability that U demands y given history H.

We assume that q_F and q_U are best reply probability distributions such that $q_F(x|d^F, h) > 0$ only if x happens to be a best response by F to the sample drawn from history H given its disposition. Similarly, $q_U(y|d^U, h)$ is presumed to be U's best reply probability distribution of bargaining strategies in a particular round given the available information and U's disposition.

In order to illustrate the evolutionary mechanism, we follow the standard method of inquiring about the possibility of the bargaining process reaching a stationary state. The aim is to show under what conditions the bargaining history between F and U may become sufficiently stable in order to explain the equilibration of beliefs (i.e. q_U and q_F tending towards $\mathrm{E}^F(q_U)$ and $\mathrm{E}^U(q_F)$ respectively). Let h' be an alternative history of round per round negotiations between F and U (equal in size to h, the number of negotiations that has already

involved F and U). We call h' a successor of h if there is a non-zero transition probability ($R_{hh'}$) that h' will follow immediately after h.

$$R^{it}_{hh'} = \Sigma_{f \in DF} \Sigma_{u \in DU} \rho_{it}(d^F, d^U) q_F(x_t | d^F, h) q_U(y_t | d^U, h). \quad (6)$$

Definition. We define a set of offers $(x^*, y^*)_t$ as a *bargaining convention* if it denotes agreement (i.e. $x^* = 1 - y^*$) and has occurred in the same round of h^* successive negotiations.

[Notice that if such a bargaining convention is realised, and provided h^* is sizeable enough, the particular choice of sample (i.e. the bargaining dispositions d^F and d^U) will no longer affect behaviour.]

Proposition 1. Once a convention is established, industrial conflict vanishes.

Proof. A convention marks an absorbing state of the generalised bargaining process described by the transition mechanism in (6). Since probabilities q_F and q_U [see (4) and (5)] are assumed to be best replies to the available information, the best reply to a history of h^* successive $(x^*, 1 - x^*)_t$ agreements in round t of each negotiation is for F to offer and for U to demand $1 - x^*$ in round t. But then as long as the costs of disagreement (c_F, c_U) are positive, and through a process of backward induction, it transpires that τ tends to 1 as the bargaining process in (6) approaches an absorbing barrier.

Assumption. If bargainers have a disposition to seek information about the current round t in d^F and d^U past negotiations which ended in a number of rounds less than t, then they look at the most recent d^F and d^U negotiations from the available record of H negotiations.

Proposition 2. If at least one bargaining disposition ($d^U \in D_U$ *or* $d^F \in D_F$) *chooses a sample of at most half of existing records* (*i.e.* $d^F, d^U \leq H/2$), *then from* any *initial state the bargaining process will converge to a convention with high probability in a finite number of negotiations.*

The above proposition is an extension of the first theorem of Young (1993) which applies to a series of Nash games played once by pairs randomly drawn from a fixed population. By showing that a convention is most likely to emerge it endogenises the equilibration of bargainers' beliefs. For if the bargaining process can be *shown* (as opposed to being *assumed*) to generate a single agreement as time goes by, then it is plausible to expect rational bargainers to align their expectations. The central difference between this result and the conventional Rubinstein-based solutions (see his 1985 paper) is that the point of agreement

$(x^*, 1-x^*)$ is one of many equally plausible outcomes and could have easily been otherwise (i.e. unlike Nash and Rubinstein the evolutionary model does not assume that the evolved settlement reflects a uniquely rational bargaining solution).

In summary, Propositions 1 and 2 suggest that the process of negotiations, rooted in its own history, founders for a while until it generates a convention. 'Foundering', in this context, translates into industrial disputes. Once a convention is in place, trades unions and firms manage to coordinate their beliefs in accordance to the established convention. The difference with equilibrium theory is that our approach appreciates the impossibility of determining *theoretically* which convention will emerge.

Sketch of proof. The aim is to show that the set of all strategy choice paths which do not lead to an absorbing state (that is, a convention) has a vanishing probability. To do this we will prove that there exists an integer I and a positive probability ξ such that the probability of converging to a convention within αI $(\alpha > 0)$ negotiations is $1-(1-\xi)^{\alpha}$. For if this is so, then as α tends to infinity the probability that a convention will be reached will tend to one. Thus the proof that a convention will be reached within a finite number of negotiations. The formal proof is located in the appendix.

Summarising Proposition 2, there exists a positive probability that a convention can be reached within a finite number of negotiations. Hence there exists a positive stationary probability (that is, independent of the particular history) that the history of negotiations will engender *some* convention which allows for agreements without industrial conflict.

3. Strikes as experiments with alternative conventions

Conventions are genuinely absorbing states to the extent that bargainers consistently choose demands as best replies to the demands of their opponents. By its very nature, a convention makes sense to each firm or union when others also subscribe to that convention. However this does not mean that a current convention is in the interest of each party, or indeed of a majority of unions or firms even if it helps them avoid costly strikes. The reason is that, as evolutionary game theory shows [see Ch. 7 in Hargreaves-Heap and Varoufakis (1995)], the evolutionary fitness of conventions is increased when they treat different types of agents in different ways. For example, a convention may give a trades union $1-x^* = 1/2$ when it is bargaining with a firm located in the manufacturing sector but only $1-x^* = 1/4$ when bargaining in the service sector.

The point here is that the emergence of the convention will benefit the average union (or indeed firm) but if some union happens to be so placed with respect to the convention that it gets the richer rewards infrequently (e.g. because its members are located mostly in the service sector), perhaps it would be better off

without the current convention. One is then justified to ask: Why does it then stick to the convention? The answer is that even though the individual union would be better off if all bargaining parties were to abandon the convention, it does not necessarily make sense to do so individually. For example, it could simply trigger a much longer strike to get something above $1 - x^*$ simply because the firm's expectations are fixed on that focal point.

However the extent to which a convention has the capacity to reproduce itself, and therefore to thwart such attempts to re-write the evolved bargaining protocol, depends on the degree to which a critical mass of bargaining units in the labour market are willing to risk some industrial conflict in order to test the stability of a particular convention. This inquisitiveness of agents is what marks them apart from the purely adaptive automata which the rational expectations hypothesis was meant to sideline.

To make the last point more sharply, in conventional equilibrium theory the urge to see ahead, and to avoid becoming bogged down in an equilibrium whose only support comes from the past, takes the form of rational expectations. Rational expectations are then derived by postulating a correct model of expectation formation and subsequently allowing bargainers access to it. However this presumes that a correct model can be specified in advance based solely on information concerning objective functions and constraints. In an evolutionary framework, the possibility of such fore-knowledge of the correct model is rejected in view of the multiplicity of equally plausible candidates out of which one materialises in a radically unpredictable manner (see Propositions 1 and 2).

In this framework forward looking agents recognise that the current convention is characterised by different degrees of stability which depend on aggregate behaviour. In the absence of uniquely rational expectations about the evolutionary stability of this convention, they do the one thing that rational agents can do: they experiment by testing the effect of their individual industrial action on aggregate bargaining behaviour. For instance, an established convention may award $1 - x = 0.6$ to workers in the construction industry and only $1 - x = 0.2$ to miners. The mining unions know that if they abandon the convention (which has them accepting 0.2 without a strike) a strike will follow.

Whether they will benefit from it depends on whether their action will cast sufficient doubt in the mind of employers at $t = 2$ as to whether their optimisation calculations, based on the current convention, are still valid. It will also depend on whether unions in other industries, who have also been doing less well as a result of the current convention, are prepared for industrial conflict. A similar story can be told about employers who decide to test the stability of a convention which discriminates against them in favour of firms in other industries. In this context, industrial conflict is the byproduct of experimentation. And unlike equilibrium theory's interpretation of conflict as a mere provider of information about exogenous types of bargaining behaviour, evolutionary theory argues that conflict helps create the prevalent types of bargaining conduct.

The next question which needs to be addressed concerns the precise form of these experiments. We discuss two types: (a) Strikes which reflect random experiments, and (b) strikes due to experiments which are causally related to some underlying historical, technological or political process.

(a) Random, uncorrelated experiments. Imagine that firms and unions test the stability of the current convention at random hoping that they can re-jig it in a manner which boosts their returns. Let v_F and v_U be the probabilities with which F and U respectively would experiment in any given round of the negotiations, and $Q_F(x|d^F, h)$, $Q_U(y|d^U, h)$ be the replies of F and U to their observations of the past when they decide to experiment. Then the transition probability from one history (h) to another (h') becomes

$$\begin{aligned} R^v_{hh'} = \sum_{f\in D^F} \sum_{u\in D^U} \rho(d^F, d^U)\{&(1-v_F)(1-v_U)q_F(x_t|d^F, h)q_U(y_t|d^U, h) \\ &+v_F(1-v_U)Q_F(x|d^F, h)q_U(y|d^U, h) \\ &+v_U(1-v_F)q_F(x|d^F, h)q_U(y|d^U, h) \\ &+v_Fv_UQ_F(x|d^F, h)Q_U(y|d^U, h)\}. \end{aligned} \tag{7}$$

When the v's are uncorrelated with each other or across different negotiations, the bargaining process may still gravitate towards a state of (mostly) industrial peace but will be punctuated with the odd strike. An occasional random build-up of experimental deviations may snowball into a chain reaction of industrial unrest which will again die down provided the variance of the v's is not too high. [5] Consider the convention towards which bargaining outcomes would have gravitated in the absence of random experiments (or strikes). Will it survive? Or will another distribution of the surplus between workers and employers become the new attractor of bargaining processes? The answer depends on the stochastic stability of the initial convention. Some will prove more resilient than others.

In technical terms, a convention h^* is stochastically stable if $R^v_{h^*h^*}$ has a unique stationary distribution according to which the bargaining process proceeds as the magnitude of the experiments vanishes. In that case, the probability that the distribution of the surplus will be determined by convention h^* exceeds at any stage the probability that it can be better explained by any other convention. [6]

(b) Historically correlated experiments: The effect of technological innovation and union politics on the probability of experimentation. Although an interesting history of industrial relations has been made possible without having to ascribe

[5] For an analysis of shock build-up see Fudenberg and Harris (1992).

[6] The literature on evolutionary stability is expanding rapidly. See Foster and Young (1990) and Kandori et al. (1993). For an alternative stability concept, consult Matsui (1992).

experimentation to anything other than rational curiosity (symbolised by random disturbances), the present approach allows more to be said on the determinants of such tendencies. We examine two cases. The first refers to technological innovations which alter the costs of conflict. Suppose for example that a convention has evolved such that a union and a firm habitually settle on $(x^*, 1-x^*)$ without conflict. Suddenly some technological innovation alters the production process in ways which affect the firm's objective function and/or conflict costs. For example, if the new technology renders redundant middle-ranking supervisors loyal to the union, the union will have lost a major weapon with which to inflict costs on the firm (e.g. in terms of shutting down production quickly). This development, by itself, may be sufficient to destabilise the convention and to give rise to a period of conflict before some other convention unfolds. The UK print media in the 1980s is a suggestive example.

The second case considers the effect of workers' expectations on the union leaders' propensity to subvert the existing convention. Noting that such a decision can only make sense provided the union's members are prepared to back their leaders' recalcitrance by walking out, it is interesting to explore the linkages between the 'experiments' with alternative conventions and the workers' beliefs. Consider the first round of some negotiation. Probability v_U relates the chance that the trades union will breach the prevailing convention $(x^*, 1-x^*)$ by rejecting the firm's $1-x^*$ offer in round $t=1$. Instead it demands in round $t=2$ $1-x'$, where $x' < x^*$. In this case, $z = x^* - x'$ is the extent to which the trades union aims to alter the portion of the surplus which has so far been retained by the firm conventionally.

For the purpose of illustrating the new analytical possibilities, let us suppose that union leaders care about what workers' expect concerning their tactics – especially if the latter involve strike calls whose success will depend entirely on how workers respond to them. Also, workers may evaluate their leaders' tactics according to what expectations they have of them. Workers, for example, may prefer their union to breach a convention and to struggle for the establishment of a more beneficial distribution of the surplus if, for some reason, this is what they expect the union to do. And conversely, they may be disappointed if the union calls for a strike which they had not anticipated. The above suggests an intricate web of beliefs which may constitute an important part of what keeps the trades union a viable organisation in the face of all sorts of prisoners' dilemmas. [7]

To extract from the above an analytical contribution, let v' be the workers' estimate of v_U and v'' the union's estimate of v':

$$v' = E_{\text{workers}}(v_U) \quad \text{and} \quad v'' = E_{\text{union}}(v').$$

[7] For an example of how a strike's success or failure may depend on the dynamics of workers' beliefs, see Varoufakis (1989).

The following table offers an analytical counterpart of the above paragraph:

	Union leaders' utility from choice of z and v_U ceteris paribus	Workers utility from choice of z and v_U ceteris paribus
Leaders choose to deviate from convention h^* by z	v''	v'
Leaders accept the convention	$1 - v''/z$	$1 - v'/z$

Note that the payoffs are arbitrary and only hope to illustrate the relative effect on the leaders' and workers' utility following the decision of the former to abide by, or to disregard, an already established rule (ie. convention) for splitting the firm's surplus between capital and labour. [8]

If workers expect a deviation from the convention (and thus a strike) with a high probability $[v' > 1/(1 + z)]$, then they prefer their leaders to deviate from the convention and call a strike. If they are not so sure that a deviation is as likely, then they will not be disappointed if their union respects the convention and settles immediately. In this example, what matters most is that workers' expectations of their leaders' bargaining tactics are confirmed. The interesting twist here is that, if the union leaders think that their constituency expects them to deviate, then they want to deviate. If not, they feel no need to break with the convention. They may still do so with positive probability, e.g. $v_U = \eta$; η:N$(0, \sigma^2)$, as part of the usual experimentation with alternative conventions, but they will not introduce a systematic disturbance in the bargaining process of Eq. (7).

Let us consider the following condition which must be satisfied for the continuation of a largely strike-free period once a convention has been established: $v_U = v' = v'' = 0$ – that is, no deviation is planned by leaders, none is expected by the workers and, finally, leaders do not feel they are expected to deviate. Notice that this outcome yields the highest possible payoff $(1/z)$ for both workers and leaders viz. the collective attitude towards the convention. Interestingly this does not mean that the convention is necessarily safe. Consider two possibilities:

Firstly, some political developments in the industry or elsewhere may generate in workers' minds the idea that the union is about to, or should, deviate from the convention and thus cause a strike. Then the leaders will be trapped in the workers' expectations which, in a never ending circle, they will have an incentive to confirm even though they are perfectly aware of the fact that this alternative equilibrium of beliefs $(v_U = v' = v'' = 1)$ yields a lower payoff for all involved.

[8] See Geanakoplos and Pearce (1989) for a general theory of interdependent beliefs and desires.

Secondly, leaders may conclude that the prevailing convention is unstable and that a reasonably intense period of industrial unrest will bring into being a far more propitious distribution of the surplus. They embark upon a political campaign whose purpose is to prepare the workers for the deviation. Once $v' > 1/(1 + z)$ they are free to deviate and reject the firm's offer at $t = 1$. Underlying this argument is the thought that a union leader preparing for a strike will want workers to approve the deviation. But as the above table reveals, all that may be required is that workers are cajoled into expecting a deviation. Once the political campaign achieves this, a deviation follows naturally.

There are two lessons from this: First, the tendency to deviate from a convention (and thus to rekindle social and industrial conflict) may be, to a significant extent, socially and politically determined. Union leaders are neither mere conduits for workers' preferences, nor unscrupulous purveyors of self-serving tactical manoeuvres. Similarly, workers are neither passive playthings of the trades union's internal politics, nor sovereign creators of bargaining strategies. Second, the fact that a particular convention may seem safe, because its continuation receives support from Pareto-dominance, does not mean that rational unions (and indeed firms) should not attempt to subvert it. [9] Industrial conflict suddenly becomes much richer a social phenomenon than the conventional theoretical view of it permits.

4. Conclusion

Hicks (1966) was not entirely wrong when he famously suggested that "... most strikes are the result of faulty negotiations". The truth of his statement hinges on the interpretation of these 'faults'. If one assumes, as equilibrium bargaining theory does, that there exists a model of uniquely rational strategies, then faults can be avoided by adopting this model and strikes happen when people are not rational enough to do so.

In contradistinction if one believes, as this evolutionary perspective recommends, that no such model can be worked out a priori, then what appear as negotiating 'faults' are the necessary steps rational bargainers must take to defeat the unavoidable indeterminacy of bargaining. Strikes are the symptom of these failed attempts along the evolutionary path to stability. They are also the symptom of the arbitrariness of any convention which opens it up to frequent challenges. Those challenges are not only a result of the rational inquisitiveness of unions and employers alike, but are a reflection of the instability of other underlying conventions as well (eg. those governing the internal politics of a trades union).

[9] Perhaps surprisingly, evolutionary game theory can show that the 'fittest' do not always survive. Thus to demonstrate that some convention is more beneficial for everyone concerned, is not necessarily to show that evolution will favour it. See Dekel and Scotchmer (1992).

All this translates into a rich history of continually established and subverted rules according to which a firm's surplus is distributed between capital and labour. Strikes are the natural symptom of the evolution of this distribution.

Appendix A. Proof of Proposition 2

Beginning with the Assumption preceding Proposition 2, the proof follows 5 steps:

Step 1: Negotiation i

Let d'^F and d'^U be the bargaining dispositions which base their actions on the least amount of information (that is, the smallest samples from existing records). Assume that their sample sizes are less than or equal to half the existing (H) records. Let one of the two dispositions (of F and U respectively) be slightly more keen to count in previous negotiations which ended before round t: say, $m = m_F \geq m_U$ [of course this inequality could have been reversed; in that case substitute m_F with m_U in what follows]. Note that during negotiation i (round t) the history of bargaining between F and U process is given by $< (x_t, y_t)_{i-m+1}, \ldots, (x_t, y_t)_i >$.

Step 2: Negotiations i + 1 to i + m

Prob(d^F and d^U bargaining dispositions will be selected every time) > 0. Prob(d'^F and d'^U will draw the same samples from history H every time) > 0. Letting (x, y) be the best replies to these particular samples, it follows that: If ϕ is a potential history of exactly (x, y) demands in round t in all of the $(i + 1$ to $i + m)$ negotiations, then the probability that ϕ will be observed in each of the $(i + 1, i + m)$ negotiations is positive.

Step 3: Negotiations i + m + 1 to i + 2m

Prob(same d'^U, d'^F dispositions will be selected) > 0. If they are selected, they may sample from history ϕ above. In this case, their best replies to those observations are $(1 - y, 1 - x)$. Let ϕ' denote a potential history of $(1 - y, 1 - x)$ demands in round t of *all* negotiations $i + m + 1$ to $i + 2m$. We conclude that: Prob(ϕ' being observed in each of the $(i + m + 1, i + 2\mathrm{m})) > 0$.

Step 4: Negotiation i + 2m + 1

Prob(same dispositions d'^U, d'^F will be selected) > 0. If they are selected, the probability that they will draw samples from ϕ' is also positive. Also, Prob(d'^F will look back $2m_F$ negotiations and $d'^U m_U$ periods) > 0. In that case, F's and U's best demands are $(1 - y, y)$.

Step 5: Negotiation $i + 2m + 2$

The history of demands ϕ has by now vanished from record (since $m = m_F < 2H$) – see the *Assumption* prior to *Proposition 2*. However d'^F can still gain access to records in which d'^U consistently demanded y. The firm's best reply to that observation is to demand $1 - y$. In the meantime d'^U has access to the more recent history in ϕ' in which the firm demanded $1 - y$. Its best reply is to demand y. In conclusion, there exists a positive probability that their pair of best demands is given by $(1 - y, y)$. Thus, Prob(a history of H negotiations with settlements $1 - y, y) > 0$.

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