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THE GENERAL BASIS OF ARBITRATOR BEHAVIOR: AN EMPIRICAL ANALYSIS OF CONVENTIONAL AND FINAL-OFFER ARBITRATION

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ABSTRACT

A general model of arbitrator behavior in conventional and final-offer arbitration is developed that is based on an underlying notion of an appropriate award in a particular case. This appropriate award is defined as a function of the facts of the case independently of the offers of the parties. In conventional arbitration the arbitration award is argued to be a function of both the offers of the parties and the appropriate award. The weight that the arbitrator puts on the appropriate award relative to the offers is hypothesized to be a function of the quality of the offers as measured by the difference between the offers. In final-offer arbitration it is argued that the arbitrator chooses the offer that is closest to the appropriate award.

The model is implemented empirically using data gathered from practicing arbitrators regarding their decisions in twenty-five hypothetical cases. The estimates of the general model strongly support the characterizations of arbitrator behavior in the two schemes. No substantial differences were found in the determination of the appropriate award implicit in the conventional arbitration decisions and the determination of the appropriate award implicit in the final-offer decisions.

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I. Introduction

Of central importance in the process of collective bargaining is the mechanism for settling disputes that arise when the parties fail to reach agreement when negotiating a labor contract. It determines not only the terms of agreement in all cases but also the probability of reaching agreement without resort to the dispute settlement mechanism.[1] While the strike is the dominant mode for settling disputes that arise in the course of negotiating labor contracts, arbitration procedures have become particularly important in areas, such as the public sector, where strikes are deemed to be too disruptive. These procedures are characterized by a third party making a binding decision. In addition, arbitration procedures, though called by different names, are used to settle disputes in a wide range of areas. For example, litigation of civil disputes is analogous to bargaining with arbitration as the dispute settlement mechanism. An out-of-court settlement is simply a negotiated settlement while an award by a judge or jury is essentially an arbitration award.[2]

The willingness of the parties to make concessions in order to reach a negotiated settlement is based largely on what they expect to receive if they do not reach agreement. In the case of arbitration, the parties' expectations regarding the outcome in the event of failure to reach a negotiated settlement depend heavily on their expectations regarding the behavior of the arbitrator.

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1. Farber and Katz (1979) and Farber (1980) develop models of the negotiation process under the threat of arbitration that highlight the role of the expected arbitration award.

2. Of course, the details of the process are quite different. For example, in most labor arbitration schemes the offers made by the parties in an attempt to reach settlement are admissible as evidence before the arbitrator. However, in civil litigation, pretrial offers to settle are not admissible as evidence. This difference can have profound effects on the bargaining process. See, for example, Wheeler (1977) and Farber (1981).

Thus, our ability to understand the effects of an arbitration scheme on the collective bargaining process without understanding the decision processes of the arbitrators themselves is quite limited. However, there has been little in the way of systematic analysis of how arbitrators actually decide.[3]

In this study two types of arbitration schemes are considered. The first is called conventional arbitration where arbitrators are free to impose any settlement they see fit. The second is called final-offer arbitration where arbitrators are constrained to make an award that is equal to either the union final offer or the management final offer.[4] While the use of conventional arbitration arbitration has been increasing, critics have argued that arbitrators tend to "split the difference" between the offers of the parties resulting in a "chilling" of bargaining and excessive reliance on the arbitrator to reach agreement.[5] This may occur as the parties maintain polar positions in order to influence the arbitration award most favorably.[6] Final-

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3. Exceptions to this are Ashenfelter and Bloom (1984), Bazerman (in press), and Bazerman and Farber (in press).

4. There are many variants of final offer arbitration. For example, where there is more than one issue in dispute, the arbitrator may be constrained to award the entire package of one party or the other or the arbitrator may be free to choose final offers on an issue by issue basis. Another variant of final-offer arbitration, used for public employees in Iowa, gives the arbitrator the third option of awarding the recommendation of a "neutral" third party (Gallagher and Chaubey, 1982). In this study we consider only the case where there is a single issue in dispute, and we use the simple conception of final-offer arbitration where the arbitrator has two discrete options.

5. Wheeler (1978) and Kochan and Baderschneider (1978) present evidence regarding the diffusion of conventional arbitration schemes. Feigenbaum (1975), Feuille (1975), Northrup (1966), Stevens (1966), Starke and Notz (1981), Bonn (1972), and Anderson and Kochan (1977) present arguments that arbitrators split the difference in conventional arbitration resulting in a "chilling" of bargaining.

6. Farber (1981) presents a theoretical model of arbitrator and negotiator behavior in conventional arbitration with implications for the pure split-the-difference model. Bazerman and Farber (in press) present an empirical analysis of arbitrator behavior that addresses the issue of splitting-the-

offer arbitration was developed in response to this criticism of conventional arbitration.

Careful analysis of the relative merits of alternative arbitration schemes requires comparisons in at least two dimensions. The first is the frequency with which the procedures induce the parties to reach a negotiated settlement without resort to an arbitrator. The second is the quality of both negotiated and arbotrated settlements. Virtually all existing work comparing conventional and final-offer arbitration has focused on settlement frequency, probably because the driving force behind the adoption of final-offer arbitration was the arguement that it is more conducive than conventional arbitration to negotiated settlemets.[7] Another important reason for this focus is that there has been no clear standard, constant across different forms of arbitration, that can serve as a basis for judging the quality of settlements.

It is argued in this study that there is a construct, called the "appropriate" award, implicit in the behavior of arbitrators that is independent of the particular type of arbitration and that is a natural standard for judging the quality of settlements. The central hypothesis is that arbitrators make decisions in the different types of arbitration schemes based on the <u>same</u> underlying appropriate award. The appropriate award is argued to be a function of the facts of a given situation independent of the offers of the parties.[8] It is a representation of what the arbitrator would

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difference directly.

7. See, for example, Kochan and Baderschenider (1978), Neale and Bazerman (1983), and Notz and Starke (1978).

8. Throughout this study the "facts of the case" refer to all considerations with the exception of the positions of the parties. In general, the facts can be considered to be exogenous to the bargaining process while the offers of the parties clearly cannot be considered exogenous.

award based on an "unbiased" examination of the facts without any knowledge of or consideration of the offers. As such, to the extent that the appropriate award is a stable and generalizable construct across different arbitration schemes, it can serve an important role as a basis for evaluating outcomes (both negotiated and arbitrated) that are reached under the threat of arbitration of various types. The plan of this study is to devlop a model of arbitrator behavior in conventional and final-offer arbitration based on the appropriate award and to implement this model empirically in order to determine whether the construct of an appropriate award, in fact, generalizes across types of arbitration.

The next section contains the development of a simple model of arbitrator decision making in conventional arbitration where it is argued that the arbitration award is a weighted average of the appropriate award and the offers of the parties. The weights are argued to be systematically related to the quality of the offers as measured by how close to agreement the parties are.[9] Section III contains the development of a simple model of arbitrator decision making in final-offer arbitration where it is argued that the arbitrator chooses the offer that is closest to the arbitrator's notion of an appropriate award.

The key to the empirical analysis is the investigation of how close the appropriate award implicit in the conventional arbitration award is to the appropriate award implicit in the final offer arbitration decision. Of course, only the actual arbitration awards are observable. The appropriate

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9. This model has as a special case the pure split-the-difference model of arbitrator behavior that serves as the basis of the critique of conventional arbitration. The empirical implementation of this model will shed light on the extent to which the arbitrator splits-the-difference as opposed to fashioning an award based on the facts of the case.

award is directly observable in neither type of arbitration so that the investigation must be based on a structural model that relates the actual arbitration award in each type of arbitration both to the facts of the case as they are hypothesized to affect the appropriate award and to the offers of the parties. The empirical test is based on the degree of correspondence between the observed and unobserved determinants of the appropriate awards in the two types of arbitration.

What are needed are data on the decisions of arbitrators in both conventional and final-offer settings along with the facts of the particular case and the offers of the parties. However, data related to arbitrators' decisions in actual cases of the sort generally analyzed have serious limitations for the problem at hand. First, it is rare that explicit last offers are recorded in situations where conventional arbitration is utilized. Second, actual cases do not include both conventional and final-offer awards in the <u>same</u> situations. Finally, the facts available to the arbitrator are generally incompletely observed by the investigator. This is crucial because all facts available to the arbitrator, including those the investigator does not observe, will affect the offers of the parties as they attempt to influence the arbitration award favorably.[10] These shortcomings are critical because the analysis relies fundamentally on identifying the role of the facts available to the arbitrator from the role of the offers in the determination of the arbitration award.

In light of these shortcomings, the models of arbitrator behavior are implemented empirically using data gathered from practicing arbitrators who

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10. Farber (1980, 1981) develops models of strategic behavior in conventional and final-offer arbitration where the offers are manipulated by the parties as they attempt to maximize the value of the outcome.

were each asked to decide the same set of twenty-five hypothetical cases. Both conventional and final-offer arbitration awards were recorded from each arbitrator for each case. In the simulation exercise used here, the arbitrators were given a precisely controlled set of information regarding the facts of each case along with information regarding the offers of the parties. All of the variation in the facts is measured in the data. Thus, the information set of the arbitrator is completely characterized by the observed facts of the case, and the last offers are available for use in analyzing the conventional as well as the final-offer arbitration awards. The fact that each arbitrator provided both conventional and final-offer awards in all situations is another advantage of these data because it facilitates the estimation of the correlation between unobservable factors that affect the determination of an appropriate award by a given arbitrator in a particular case. This correlation will prove to be an important part of the empirical analysis given that the facts and the offers do not explain all of the variation in arbitration awards.

In section IV the design of the simulation exercise is discussed and the resulting sample is described. Section V contains the empirical specifications of the models of arbitrator choice along with a discussion of some conceptual issues that have implications for the econometric specification. An unconstrained model that allows for completely different determinants of the appropriate award in the two types of arbitration is proposed. At the same time it allows for correlation between unobserved factors that affect the appropriate awards in the two types of arbitration. A fully constrained model is also proposed where it is assumed that the appropriate award is determined in exactly the same way in both types of arbitration is also proposed. Finally, two partially constrained models are proposed, the estimates of which will shed additional light on how the appropriate awards might differ across arbitration schemes.

In section VI the various models are estimated using the data from the simulated arbitrations. It is found that the determinants of the appropriate awards are remarkably similar. All of the parameters determining the appropriate award in conventional arbitration are very close to the parameters determining the appropriate award in final-offer arbitration. At the same time the unobserved factors affecting the appropriate awards are very highly correlated. While it is possible to reject the hypothesis that the appropriate awards are identical, there seems to be no substantive difference across types of arbitration.

The final section contains a brief summary of the findings as well as a discussion of their implications for the evaluation of arbitration schemes and the role of arbitration in the collective bargaining process.

II. Arbitrator Behavior in Conventional Arbitration

Consider an arbitrator who must make a decision regarding a single issue such as the wage change to prevail in a collective bargaining agreement.[11] While it is not possible to characterize completely the objectives of the arbitrator, one possible motivation for arbitrators is that they attempt to make awards that maximize the probability they will be hired in subsequent cases, either by the same parties or by others who are aware of their performance. The process by which arbitrators are selected for cases varies

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11. Where there is more than one issue to be decided, the details of the analysis become more complicated but its qualitative nature is unchanged for the purposes of this study.

across settings, but it is generally true that <u>both</u> parties have a limited veto power. For example, New Jersey's statutory procedure for selection of arbitrators in disputes involving police and firemen requires that the New Jersey Public Employment Relation Commission present a list of seven potential arbitrators to the parties, each of whom is instructed to veto three names and indicate their preference ranking over the remaining four.[12] Clearly, selection procedures such as this provide the incentive for the arbitrator to avoid making awards are that are unacceptable to either party. Maintaining acceptability with both parties affects the arbitrator's general professional reputation and the frequency with which he or she will be hired in the future.

The arbitrator who is attempting to establish a general professional reputation will want to maintain acceptability both in terms of the offers of the parties and the facts of the case. Such a reputation cannot be established by making an award that simply avoids a settlement that is too far away from either party's final offer. The arbitrator's professional reputation is also affected by the degree to which his/her settlements are known to be consistent with the facts of the case. Evidence consistent with this view is provided by Bloom and Cavanaugh (1984), who find that the preferences of the union and the employer regarding appropriate arbitrators in specific cases are not in direct opposition. The interpretation of this is that certain arbitrators are successful at being perceived as fair and are more likely to be ranked highly by both union and management in particular cases.

A behavioral rule for the arbitrator consistent with the preceding

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12. This procedure is described by Bloom and Cavanaugh (1984), who present an analysis of the preferences of the parties across arbitrators.

argument is that the arbitrator makes an award that minimizes the sum of squared deviations of the award from each party's last offer (Y_u and Y_m for union and management respectively) and each party's notion of an appropriate award (Y_{eu} and Y_{em} for union and management respectively). These appropriate awards are assumed to be determined by a set of economic and political factors (the facts) that are not influenced directly by the parties' behavior. The loss function (V) associated with this decision rule is

$$(1) \quad V = \gamma[\alpha(Y_s-Y_{em})^2+(1-\alpha)(Y_s-Y_{eu})^2] + (1-\gamma)[\delta(Y_s-Y_m)^2+(1-\delta)(Y_s-Y_u)^2]$$

where Y_s represents the arbitration award. The parameters α and δ are fixed weights. The parameter γ represents the weight put on deviations from the parties' notions of an appropriate award relative to deviations from the offers.

It seems reasonable to argue that the weight (γ) on the facts relative to the offers is a function of the quality of the offers. If the offers are close together, the indication is that the parties are close to agreement and the offers become of primary importance (γ is small) in determining what outcomes are acceptable. On the other hand, if the offers are farther apart, the penalty to the arbitrator for deviation from the offers is likely to be smaller so that the facts become of primary importance (γ is large). More formally,

$$(2) \quad \gamma = g(Y_u - Y_m)$$

where $g(\cdot)$ is a monotonically increasing function of its argument.

The optimal (loss minimizing) arbitration award based on these considerations is

$$(3) \quad Y_s^* = \gamma Y_e + (1-\gamma)(\delta Y_m + (1-\delta)Y_u)$$

where Y_e is the weighted average of the management and union notions of an appropriate award. This is

(4) $\quad Y_e = \alpha Y_{em} + (1-\alpha) Y_{eu}$.

This quantity (Y_e) is called here the arbitrator's notion of an appropriate award. The value of Y_e has normative appeal to the extent that it summarizes the arbitrators interpretation and synthesis of the needs of the parties as a function of the economic and political environment. In a limited sense it represents the ideal award.

The key result is that the optimal award for the arbitrator to make is a weighted average of the appropriate award (Y_e) based on the facts and the offers of the parties where the weight (γ) depends on the quality of the offers. This characterization of the arbitration award is intuitively plausible, and it need not depend on the specific parameterization of the optimization process outlined here.

The optimal arbitration award defined in equation (3) has a number of interesting special cases. First, if $\gamma=1$ then only the facts are important and the arbitrator ignores the offers. Second, if $\gamma=0$ and $\delta=1/2$ then the arbitrator simply splits the difference between the offers of the parties without regard to the facts. Third, a more general split-the-difference model is the special case where $\gamma=0$ but δ is unconstrained. Finally, the notion that the weight on Y_e relative to the offers is a function of the quality of the offers can be tested by assuming an appropriately general specification for γ. All of these special cases are tested using the estimates of the model presented below.

III. Arbitrator Behavior in Final-Offer Arbitration

In final-offer arbitration the arbitrator is constrained to make an award that is equal to the union final offer or the management final offer. No compromise is allowed. Suppose that the arbitrator must choose between final offers specifying a single issue, such as the wage change to prevail in a collective bargaining agreement.[13] Assume that the underlying motivation of the arbitrator in final offer arbitration is identical to the motivation in conventional arbitration: to maximize the probability of being hired in the future. However, the arbitrator must signal the quality of the award simply by the choice of one offer or the other. The problem for the arbitrator is to decide which offer is more likely to be deemed acceptable. This requires an evaluation of the offers in the context of the relevant facts regarding the economic and political environment. In more formal terms, the arbitrator in final-offer arbitration can be conceived of as selecting the offer that minimizes the value of some loss function. However, there is no reason to believe that the appropriate loss function in final-offer arbitration is the same loss function that is appropriate in conventional arbitration. The structure of the process is quite different, and the offers play very different roles in the two types of arbitration.

Assume that the loss function of the arbitrator in final-offer arbitration is a weighted sum of squared deviations of the selected offer only from the appropriate outcomes of the parties (Y_{em} and Y_{eu}) and not from the

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13. As discussed in the introduction, where there is more than one issue in dispute, final-offer arbitration can take on a number of different forms. By assuming that a single issue is in dispute, the definition and analysis of final-offer arbitration is simplified without losing the central features of the process. See Crawford (1979) for an interesting analysis of negotiation under the threat of arbitration where there is more than one issue in dispute.

the offers.[14] This loss function is

$$(5) \qquad V = \alpha(Y_s - Y_{em})^2 + (1-\alpha)(Y_s - Y_{eu})^2.$$

Since the arbitrator is constrained to impose one or the other of the offers as the award, the optimal award from the arbitrator's point of view is the offer that yields the lower value for the loss function defined in equation (5). It is straightforward to derive the result that the management's offer will be selected if and only if

$$(6) \qquad (Y_u + Y_m)/2 < Y_e$$

where Y_e is defined in equation (4) as the arbitrator's notion of an appropriate award. This result has the intuitively appealing interpretation that the arbitrator selects the offer that is closest to Y_e.[15,16]

In summary, arbitration awards in both conventional and final-offer arbitration depend on the offers a common underlying variable called the

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14. It would be odd for the squared deviations of the award from the offers to enter directly in the loss function in final-offer arbitration because the arbitrator must select one offer or the other. The contribution to the loss function would always be zero from the offer selected and the weighted square of the difference between the offers for the offer not selected. Indeed, if the weights are equal (i.e., δ=1/2 in equation 3) then the contribution to the loss function from this source would be independent of the arbitration award.

15. A more general characterization of arbitrator choice in final-offer arbitration is that the arbitrator does not weight deviations from Y_e by the management and union equally. This is equivalent to assuming that the arbitrator compares Y_e to an arbitrary weighted average of the offers. While not presented in this study, estimates of such a model yield virtually no improvement in the fit, and the hypothesis that the weights are equal (1/2) cannot be rejected at any reasonable level of significance. This is equivalent to the result reported by Ashenfelter and Bloom (1984).

16. If it is assumed that in final-offer arbitration the arbitrator minimizes the same loss function that was minimized in conventional arbitration, the optimal award in final-offer arbitration is the offer that is closest to the optimal award in conventional arbitration defined in equation (3). Empirical implementation of this alternative formulation leads to the conclusion that the relationship in (6) is an adequate characterization of the arbitrator's decision rule in final-offer arbitration. Indeed, for specific values of γ and δ (γ=1 or δ=1/2) it can be shown that the alternative formulation collapses to the decision rule defined in (6).

appropriate award (Y_e). In conventional arbitration the award is a weighted average of Y_e and the offers where the weights depend on the quality of the offers, while in final-offer arbitration the award is the offer that is closest to Y_e.

IV. The Data: Design of the Simulation and Characteristics of the Sample

The models developed in this study are implemented empirically using data collected from a set of simulations administered to practicing arbitrators. The simulation materials were sent out to the entire membership of the National Academy of Arbitrators (NAA) and the participants in a regional meeting of the American Arbitration Association (AAA). Each arbitrator was asked to judge twenty-five hypothetical interest arbitration cases where the only remaining unresolved issue was wages. They were asked to provide the wage award for a contract of one year duration that they would make under a conventional arbitration scheme. They were also asked to provide the offer that they would select in a final-offer arbitration scheme. Along with their judgments in the twenty-five cases each arbitrator was asked to supply information regarding his or her background and experience. Arbitrators were required to supply their names and addresses with their response only if they wished to receive a copy of the results. Anonymity was guaranteed, and responses were sent back in a provided business reply envelope.

Of 584 sets of materials mailed, sixty-four arbitrators provided usable responses. A total of 1522 usable arbitration decisions from the sixty-four arbitrators were obtained and are used in the subsequent analysis.[17] The mean

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17. This is an average of 23.7 (out of 25 possible) valid responses per

age of the response group was 59 years, and all but two of the respondents were male.[18] The mean number of interest arbitration cases that had been heard by members of the response group was 29, while the the mean number of arbitration cases of all sorts that had been heard was 886. Unfortunately, there exists no comprehensive survey of members of the NAA that could be used to determine if the response group is representative of the population of arbitrators as a whole. However, some ongoing research by Helburn and Rogers (personal communication, 1983), who obtained 286 responses to a survey of NAA members (a response rate in excess of 50 percent) that required far less time from participants, presents an interesting contrast. Their sample had an average age of 60.5 years. The mean number of interest arbitration cases heard by their respondents was 13.1, and the mean number of total arbitration cases heard by their respondents was 295.3. Thus, the smaller number of respondents to the survey used in the current study had a very similar mean age to this large sample. At the same time, the current sample possesses significantly more experience in arbitration of both types. This is consistent with the notion that arbitrators self-selected at least in part on the basis of interest arbitration experience. It is also likely that those who responded were those who felt most comfortable making an award on the basis of the information provided and who believe that the salient features of a real collective bargaining situation can be captured in a simulation. It is difficult to speculate about the effect that these selection criteria might

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arbitrator. Some arbitrators responded only to some of the scenarios, and some responses were deleted due to obvious errors on the part of the respondents in writing their award.

18. The mean characteristics of the respondents are based on the sixty of the sixty-four arbitrators who provided their personal characteristics along with their judgments.

have on the results.

The simulations are cast in the private sector despite the fact that most experience in the United States with interest arbitration is in the public sector. One important reason is that there is more room for presenting cases to the arbitrators that are diverse in the sense that they are located in different settings while at the same time controlling the relevant factors in a precise manner. For example, in the private sector there are a large variety of industries and occupations that can be incorporated into the scenarios. In the public sector there is only one industry by definition, and the number of occupations is quite limited. The scenarios used here are much more likely to be effective in manipulating the facts from the arbitrators perspective if the industrial and occupational settings differ sharply from case to case. Arbitrators may be more prone within an industry or the public sector to make comparisons (implicit or explicit) between scenarios that are unintended from the researcher's point of view and destructive of the analysis. Overall, we would further argue that the sort of decision processes that are the focus of this analysis generalize beyond the particular sector. The forces that influence arbitrator behavior are likely to be similar, and much can be learned about arbitrator behavior in general from examination of the particular scenarios used here.

In order to maintain parallelism between cases while providing necessary diversity, twenty-five industries were identified that had varying average national wages in 1980. These national wages were adjusted very slightly to create a systematic pattern of twenty-five national wages that varied from .40, .45, .50, . . . 1.55, 1.60 times \$8.66, where \$8.66 was the mean of all twenty-five actual national industry average wages. These adjusted national wages were used as a basis for the computation of some of the factors as described below. Two additional criteria were used in selecting the particular values for each factor. First, it was desired that the scenarios develop wage increases rather than wage declines. Second, it was necessary for the union's final offer exceed that of the management for obvious reasons in all scenarios.

Along with information on the national wage, each scenario contained information on seven factors.:

- The inflation rate was stated to be 7%, 9%, 11%, 13%, or 15%.
- The average wage increase of other contracts in the industry was stated to be 6%, 8%, 10%, 12%, or 14%.
- The average local wage for similarly qualified employees was stated to be equal to the average national wage in the industry times 87%, 94%, 101%, 108%, or 115%.
- The present wage was stated to be equal to the average national wage times 96.5%, 98%, 99.5%, 101%, or 102.5%.
- The financial health of the firm was stated to be terrible, poor, fair, good, or excellent.[19]
- Management's final offer was stated to be equal to the average national wage in the industry times 104%, 105.5%, 107%, 108.5%, or 110%.
- Union's final offer was stated to be equal to the average national wage in the industry times 111.5%, 113%, 114.5%, 116%, or 117.5%.

Each of the twenty-five hypothetical cases was described in a paragraph

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19. This is the only one of the factors that is qualitative rather than quantitative. The reason is that there is no clear measure of financial health that could generalize across industries and would be familiar to arbitrators. For example, a "good" rate of profit varies considerably across industries. The empirical specification takes account of the ordinal nature of this measure.

in terms of the seven criterion factors. The scenarios were designed to ensure orthogonality between factors with regard to the underlying ordinal rankings.[20] In the total set of twenty-five cases there were five cases for each of the five levels of each factor.[21] While the cases were presented to each arbitrator in the same sequence, this sequence was chosen randomly with respect to the factors that were manipulated. This was done in order to minimize the possiblity that the order of the cases would influence the decisions. The following is an example of a simulated case.

<u>Situation 18</u>

> In a town of 102,000 people, workers with similar skills and backgrounds to the employees of this radio and broadcasting company were paid $8.31/hr., while the national wage in this industry was $8.23/hr. The financial outlook for this company is fair in light of the 11% inflation rate. The present average wage for this company's union is $8.44/hr. Contract negotiations have reached an impasse. Both sides, however, have agreed to submit final offers to you, the arbitrator, and to be bound by your decision for a period of one year. Comparable pay increases from collective bargaining agreements in the industry are running about 8% this year. Management's final offer is $8.56 (a 1.4% increase) and the union's final offer is $9.55 (a 13.2% increase).

There is considerable variation in the responses of the arbitrators within particular cases. The standard deviation of the percent wage increase awarded by the arbitrator in conventional arbitration in a particular case is never below 1.1 percentage points and it is generally much larger. The maximum is approximately 2.7 percentage points. The average standard

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20. This design was selected for the purposes of other research using the same data. See Bazerman (in press). This design does not imply exact orthogonality with regard to the actual levels of the factors. Interested readers can contact the authors for more information.

21. Of course, this does not exhaust all of the possible interactions between factors. There are a total of 78125 (=5^7) possible combinations of the five levels of seven factors, and there are many sets of twenty-five cases with the desired properties. The set selected is arbitrary in this regard.

deviation across the twenty-five cases is approximately 1.75 percentage points. Similarly, there is considerable variation in the final offer awards within particular cases. There was an average of 61 responses per scenario (1522/25), and in only two scenarios did all of the responding arbitrators select the same final offer. In only eleven of the twenty-five scenarios did fewer than five arbitrators select a particular offer. Thus, arbitrators differ substantially in their evaluation of any particular scenario in both types of arbitration, and these differences may be a major source of the uncertainty that has been argued to drive collective bargaining where arbitration is the dispute settlement mechanism (Farber and Katz, 1979; Farber, 1980, 1981).

The empirical analysis of arbitration awards is based on the proportional wage increase awarded by the arbitrators. This can be approximated by the difference between the logarithm of the wage level awarded and the logarithm of the present wage. On this basis the relevant form for the explanatory variables that measure wages are as log differences from the present wage. The only variables that do not measure wages or proportional changes are the variables measuring the financial condition of the company. Two dichotomous variables were created to measure variation in this dimension. The first (CONDB) equals one if the financial condition of the firm was terrible or poor, and it equals zero otherwise. The second (CONDG) equals one if the financial condition of the firm was good or excellent, and it equals zero otherwise. The omitted category is a firm financial condition of fair. The definitions, means, and standard deviations of the variables used in the empirical analysis are contained in Table 1.

Preliminary examination of the arbitrator's responses uncovered an interesting phenomena that is not apparent from the information in table 1 and that fundamentally affects the empirical analysis. Of the 1522 conventional arbitration awards that were analyzed, fully 389 (25.6%) were exactly equal to either the union's or the management's last offer. All but 8 of the 64 arbitrators had at least one award that was equal to one of the offers. A reasonable explanation for this is based on the property of the scenarios that they were designed arbitrarily without regard for the plausibility of the offers vis a vis the facts.[22] In those situations where the offers were skewed relative to the facts (both very low or both very high), the arbitrators often seemed to feel constrained not to stray outside the boundaries set by the offers though they were free to do so.[23] In some cases the arbitrators did not feel so constrained. In 196 cases (for 31 arbitrators) the award lay outside the boundaries. While not analyzed in detail, the pattern of awards within arbitrators suggests that some arbitrators are very reluctant to make an award outside the boundary. These arbitrators had a relatively large number of cases on the boundary. Other arbitrators felt relatively free to make awards outside the boundaries, and they had few cases on the boundaries. Only two arbitrators were never on a boundary or outside the boundaries.

With regard to the analysis of arbitrator decision making, the issue of why some arbitrators are more likely to make awards outside the range of the offers is a complicating factor that will not be addressed in any detail here. Indeed, such extreme cases are likely to occur only rarely if at all in actual

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22. If actual data were used it is unlikely that offers that were so "pathological" relative to the facts would be observed. They only occur here because of the independent variation of the facts and the offers. This independent variation is an important strength of the data used here.

23. In terms of the loss function, this suggests that there are discontinuities at the boundaries that make it more costly to venture outside in some situations.

practice. The approach taken is to develop an appropriate econometric specification that accounts for when arbitrators in conventional arbitration will be <u>either</u> on a boundary <u>or</u> outside the boundary without specifying which of these conditions hold. This approach, discussed in detail in the next section, allows us to proceed with the analysis of the decision processes of arbitrators where there is a "normal" configuration of the facts and offers without confounding the analysis with the boundary problem.

V. The Empirical Specification

In order to implement the models of arbitrator choice outlined in sections II and III, a specification of the arbitrator's notion of an appropriate settlement in each form of arbitration is required. Denote the appropriate awards in conventional and final-offer arbitration by Y_{ec} and Y_{ef} respectively. These must be based only on the facts of the case and not on the offers of the parties. Convenient specifications are

$$(7) \qquad Y_{ec} = X\beta_c + \varepsilon_c$$

and

$$(8) \qquad Y_{ef} = X\beta_f + \varepsilon_f$$

where X represents a vector of variables reflecting the facts, β_c and β_f represents vectors of parameters, and ε_c and ε_f are stochastic components representing unmeasured factors affecting Y_{ec} and Y_{ef} respectively. The vector X includes a constant and variables measuring 1) the rate of inflation; 2) negotiated settlements in comparable situations; 3) the differential between the local wage for comparable work and the present wage; 4) the differential between the national wage in the industry and the present wage; 5) the logarithm of the present wage; and 6) the financial condition of the company.

The criterion function for choosing the management offer in final-offer arbitration, contained in equation (6), can be written after substituting from equation (8) for Y_{ef} as

(9) $\quad \Pi = (Y_u+Y_m)/2 - X\beta_f - \varepsilon_f.$

The management's offer is selected if

(10) $\quad \varepsilon_f < (Y_u+Y_m)/2 - X\beta_f,$

and the union's offer is selected otherwise. Assuming a normal distribution with zero mean for ε_f, the analysis of final offer arbitration awards is a simple probit. Note that, unlike the usual probit analysis, the variance of ε_f is identified due to the fact that the average offer enters the criterion function with a known coefficient (=1).

The empirical analysis of conventional arbitration awards is more complicated due to the boundary problem. Assuming an additive error, the general model that relates Y_e and the offers to the optimal conventional arbitration award, contained in equation (3), can be rewritten as

(11) $\quad Y_s^* = \gamma Y_{ec} + (1-\gamma)[\delta Y_m + (1-\delta)Y_u] + \mu.$

where Y_{ec} is the value of Y_e in conventional arbitration and μ is a stochastic component representing unmeasured factors affecting Y_s^*. After substitution from equation (7) for Y_{ec}, this relationship is

(12) $\quad Y_s^* = \gamma X\beta_c + (1-\gamma)[\delta Y_m + (1-\delta)Y_u] + \gamma\varepsilon_c + \mu$

where β_c and ε_c refer to the values of β and ε for conventional arbitration. A final quantity that needs to be specified for the analysis of conventional arbitration awards is the weighting function that determines γ. This is specified as the simple linear function

(13) $\quad \gamma = \gamma_0 + \gamma_1[Y_u - Y_m]$

where γ_0 and γ_1 are parameters to be estimated. The notion that the relative weight on the facts is larger when the offers are farther apart is embodied in this specification as a positive value for γ_1.

Specification of the optimal arbitration award as a continuous function of Y_{ec} and the offers is not consistent with the bunching of arbitration awards at the boundaries under standard assumptions regarding the distributions of the random components (ϵ and μ). It also seems clear that the specification of the optimal arbitration award defined in equation (11) is valid only for awards that lie between the offers. Where Y_{ec} is on a boundary or outside the range defined by the offers, a different process determining Y_s^* may prevail. What is required is an empirical specification that accounts for when an award will be on the boundary or outside and, hence, determined by a different (unspecified) process.

An appropriate statistical model is based on the notion that the process that determines Y_s^* in equation (11) is censored in that the process is only observed if Y_{ec} is interior to the offers.[24] In this context, the decision process of arbitrators can be thought of as a sequential process. The arbitrator formulates a notion of an appropriate settlement (Y_{ec}) and compares this to the offers. If the offers surround Y_{ec} ($Y_m<Y_{ec}<Y_u$) then the arbitrator makes an award that is the function of Y_{ec} and the offers defined in equation (11). If the offers do not surround Y_{ec} then the arbitrator makes an award on some basis that is not articulated here except that it is either on a boundary or outside the boundaries defined by the offers. This alternative decision process does not have to be the same for all arbitrators

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24. This is only one of a number of potential censoring processes that could be used. Other specifications were tried, and the results were qualitatively similar. The approach presented here provided the best fit to the data.

or all cases. The key is that little structure is imposed on the data for these observations. The data on the actual arbitration award (Y_s) is used for these observations only to the extent that they have information about the relationship between Y_{ec} and the offers.

More formally, the quantity Y_s^* is observed only if Y_{ec} is interior to the offers, and in this case Y_s^* is equal to the actual arbitration award (Y_s). On the other hand, if Y_{ec} is less than or equal to Y_m then the actual arbitration award is less than or equal to Y_m. Similarly, if Y_{ec} is greater than or equal to Y_u then the actual arbitration award is greater than or equal to Y_u. Essentially, the unobserved value of Y_{ec} is used in determining whether an arbitration award corresponding to the process defined above is observed. Thus, Y_s^* is censored based on the value of Y_{ec} relative to the offers.

The next step is to derive the probabilities associated with observing Y_s of a given value. The probability of observing an award that is less than or equal to the management offer is

$$(14) \quad Pr(Y_s \leq Y_m) = Pr(Y_{ec} \leq Y_m) = Pr(\varepsilon_c \leq Y_m - X\beta_c).$$

Similarly, the probability of observing an award that is greater than or equal to the union offer is

$$(15) \quad Pr(Y_s \geq Y_u) = Pr(Y_{ec} \geq Y_u) = Pr(\varepsilon_c \geq Y_u - X\beta_c).$$

Finally, the joint probability density of observing an award that is between the offers and that has a value equal to Y_s^* is

$$(16) \quad Pr(Y_m<Y_s<Y_u,\ Y_s=Y_s^*) = Pr(Y_m<Y_{ec}<Y_u,\ Y_s=Y_s^*)$$

$$= Pr(Y_m-X\beta_c<\varepsilon_c<Y_u-X\beta_c,\quad \mu+\gamma\varepsilon_c=Y_s-\{\gamma X\beta_c+(1-\gamma)[\delta Y_m+(1-\delta)Y_u]\}).$$

In other words, for all observations it is known in what range the value of Y_{ec}, and hence ε_c, falls. However, Y_s^*, and hence $\mu+\gamma\varepsilon_c$, is observed only if Y_{ec} is between the offers.

The key to the test of the model of arbitrator behavior is an analysis of how close the arbitrator's notions of an appropriate award (Y_{ec} and Y_{ef}) are in the two types of arbitration. It is assumed throughout this analysis that the random components of the model (ε_c, ε_f, and μ) are distributed as a trivariate normal. Although Y_{ec} and Y_{ef} are not observed directly, their relationship with the facts can be estimated. More formally, the hypothesis that $\beta_c=\beta_f$ can be tested directly. In addition, the correlation between the unobserved components affecting Y_{ec} and Y_{ef} (ε_c and ε_f) can be estimated. However, it is not possible to apply a standard test for the equality of these random variables because equality implies equal variances along with unit correlation, and the latter is on the boundary of the parameter space.

In order to examine the congruence between Y_{ec} and Y_{ef}, four versions of a joint model of arbitrator choice are estimated. The most general unconstrained model allows β_c and β_f to have distinct values while allowing for correlation between the three unobservables in the model (ε_c, ε_f, and μ). The likelihood function for this model is derived from the joint probabilities of four distinct events under the assumption of trivariate normality of the errors.[25] Letting Y_{sf} represent the arbitration award in final offer

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25. Note that there are a total of six conceptually possible events. However, two of these events are clearly pathalogical in some way, and these probabilities are not specified here. One is the case where the conventional

arbitration and Y_s represent the conventional arbitration award, the first is the joint probability that the conventional award is less than or equal to the management final offer and the final-offer award is equal to the management final offer. This probability is

$$(17) \quad Pr(Y_s \le Y_m,\ Y_{sf}=Y_m) = Pr(\varepsilon_c \le Y_m - X\beta_c,\ \varepsilon_f < [Y_u+Y_m]/2 - X\beta_f).$$

The joint probability that the conventional award is greater than or equal to the union final offer and the final offer award is equal to the union offer is

$$(18) \quad Pr(Y_s \ge Y_u,\ Y_{sf}=Y_u) = Pr(\varepsilon_c \ge Y_u - X\beta_c,\ \varepsilon_f > [Y_u+Y_m]/2 - X\beta_f).$$

Next, the joint probability that the conventional award lies between the offers and is equal to Y_s^* and the final-offer award is equal to the management offer is

$$(19) \quad Pr(Y_m < Y_s < Y_u,\ Y_s = Y_s^*,\ Y_{sf}=Y_m)$$

$$= Pr(Y_m - X\beta_c < \varepsilon_c < Y_u - X\beta_c,\ \mu + \gamma\varepsilon_c = Y_s - \{\gamma X\beta_c + (1-\gamma)[\delta Y_m + (1-\delta)Y_u]\},$$

$$\varepsilon_f < [Y_u+Y_m]/2 - X\beta_f).$$

Finally, the joint probability that the conventional award lies between the offers and is equal to Y_s^* and the final-offer award is equal to the union offer is

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award is less than or equal to the management offer while the final-offer award is equal to the union offer. The second is where the conventional award is greater than or equal to the union offer while the final-offer award is equal to the management offer. There were eight such cases in the original sample, and it was decided that they were most likely the result of response error. These observations were deleted from the sample used for estimation.

$$(20)\quad \Pr(Y_m<Y_s<Y_u,\ Y_s=Y_s^*,\ Y_{sf}=Y_u)$$

$$= \Pr(Y_m-X\beta_c<\varepsilon_c<Y_u-X\beta_c,\ \mu+\gamma\varepsilon_c=Y_s-\{\gamma X\beta_c+(1-\gamma)[\delta Y_m+(1-\delta)Y_u]\},$$

$$\varepsilon_f>[Y_u+Y_m]/2-X\beta_f).$$

In the next section, maximum likelihood estimates of the parameters of this model are presented. These parameters include β_c, β_f, γ_0, γ_1, δ, and the six elements of the covariance matrix of the errors.

The second version of the model to be estimated is a constrained model (constrained #1) where $Y_{ec}=Y_{ef}$ in <u>all</u> respects. Essentially, it is assumed that $\beta_c=\beta_f$ and that $\varepsilon_c=\varepsilon_f$. Denote the constrained value of β_c and β_f by β, and denote the constrained value of ε_c and ε_f by ε. It is straightforward to show that the probability of the first event, that the conventional award is less than or equal to the management offer and the final-offer award is equal to the management offer is

$$(21)\quad \Pr(Y_s\le Y_m,\ Y_{sf}=Y_m) = \Pr(\varepsilon\le Y_m-X\beta).$$

The probability of the second event, that the conventional award is greater than or equal to the union offer and the final-offer award is equal to the union offer is

$$(22)\quad \Pr(Y_s\ge Y_u,\ Y_{sf}=Y_u) = \Pr(\varepsilon\ge Y_m-X\beta).$$

Next, the joint probability that the conventional award lies between the offers and is equal to Y_s^* and the final-offer award is equal to the management offer is

$$\text{(23)} \quad \Pr(Y_m<Y_s<Y_u,\ Y_s=Y_s^*,\ Y_{sf}=Y_m)$$

$$= \Pr(Y_m-X\beta<\epsilon<[Y_u+Y_m]/2-X\beta,\ \mu+\gamma\epsilon=Y_s-\{\gamma X\beta+(1-\gamma)[\delta Y_m+(1-\delta)Y_u]\})$$

Finally, the joint probability that the conventional award lies between the offers and is equal to Y_s^* and the final-offer award is equal to the union offer is

$$\text{(24)} \quad \Pr(Y_m<Y_s<Y_u,\ Y_s=Y_s^*,\ Y_{sf}=Y_u)$$

$$= \Pr([Y_u+Y_m]/2-X\beta<\epsilon<Y_u-X\beta,\ \mu+\gamma\epsilon=Y_s-\{\gamma X\beta+(1-\gamma)[\delta Y_m+(1-\delta)Y_u]\}),$$

Given the assumption of joint normality of the errors, the likelihood function of this model can be derived from these probabilities. The maximum likelihood estimates of the parameters of this model (β, γ_0, γ_1, δ, and the three elements of the covariance matrix of ϵ and μ) are presented in the next section.

The third specification of the model is a constrained version (constrained #2) of the general model, defined in equations (17) - (20), where no correlation is allowed between ϵ_f and either ϵ_c or μ. However, β_c and β_f are allowed to differ. This is equivalent to estimating the models of conventional and final-offer arbitration separately. In other words, these estimates can be derived from a simple probit model of arbitrator choice in final offer arbitration and the model of arbitrator decision making in conventional arbitration that is defined in equations (14) - (16). These can be thought of as the models based on the marginal distributions of the underlying random variables. The maximum likelihood estimates of the parameters of this model (β_c, β_f, γ_0, γ_1, δ, and the four free components of the covariance matrix of the errors) are presented in the next section.

The final specification of the model is a constrained version (constrained #3) of the general model, defined in equations (17) - (20), where $\beta_c=\beta_f$ but where ε_c is allowed to differ from ε_f though correlation is allowed for. This can be interpreted as assuming that the systematic determinants of Y_{ec} and Y_{ef} are identical while the random components may differ. An alternative interpretation is that $Y_{ec}=Y_{ef}$ in all respects while there is an additional error component in the final-offer decision rule that causes a deviation from a strict comparison between the average offer and Y_{ef}. The maximum likelihood estimates of the parameters of this model (β, γ_0, γ_1, δ, and the six components of the covariance matrix of the errors) are presented in the next section.

Note that the sample design seems to be a natural for application of an error components model of some sort. There are multiple observations for each arbitrator, and it is known that the arbitrators differ systematically in their awards (Bazerman, in press). If these systematic differences are not accounted for, the inferences based on the estimates will not be reliable due to the correlation that is induced between the stochastic terms across cases for a particular arbitrator. One approach to accounting for this correlation in the likelihood function is to assume that arbitrators differ systematically in their mean values of an appropriate award (Y_e) in both conventional and final-offer arbitration. This is equivalent to an error components structure on ε.[26] This structure can be accommodated by including a vector of

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26. In the conventional arbitration model there is more than one error (ε and μ) so that assuming systematic differences across arbitrators in Y_e is not the only possible solution. For example, another approach would be to assume that the mean value of μ varies systematically across arbitrators (an errors components structure on μ). Yet a third approach would be to allow the

arbitrator specific dummy variables in the data vectors determining Y_{ec} and Y_{ef}.[27]

It is not likely that the introduction of fixed effects will change the estimates or the inferences substantially. This is because each arbitrator was given the same set of twenty-five cases so that the explanatory variables (X, Y_m, Y_u) are the same for all arbitrators in each case.[28] In this situation it can be shown for ordinary least squares (OLS) models that the estimates derived without fixed effects are identical to those obtained when fixed effects are included. In addition, it can be shown that the standard errors derived from models including fixed effects must be smaller than those derived from models without fixed effects.[29] Thus, any hypothesis testing done on the basis of OLS estimates without fixed effects will be conservative. While these results are not precisely true for the nonlinear model proposed here, they are likely to be approximately true.

The results reported in the next section are for specifications which do not include fixed arbitrator effects. With the exception of the fully unconstrained model, all of the models have been estimated including fixed

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decision processes of arbitrators to differ more generally. Bazerman (in press) presents an analysis of the formulation of awards under conventional arbitration that accounts for differences between arbitrators in a number of dimensions.

27. There are 25 observations for most arbitrators so that the standard problem of inconsistency in nonlinear fixed effect models due to small numbers of repeat observations is not likely to be a serious problem. A random effects specification was considered. However, evaluations of very high order normal CDFs would be required, and the computational burden was deemed excessive.

28. This is not precisely true due to the fact that there are some missing observations.

29. The analysis of errors components models in this context is formally identical to the well known seemingly-unrelated-regression problem. Note that these considerations are independent of whether, in fact, the fixed effects differ significantly across arbitrators.

effects.[30] While the hypothesis that the fixed effects are equal could be rejected in all cases, the estimates of the parameters of interest and their asymptotic standard errors were virtually identical to the estimates derived without fixed effects. In addition the qualitative nature of the outcomes of the tests of the competing models were not affected by the inclusion of the fixed effects.

VI. The Empirical Results

The first two columns of table 2 contain the maximum likelihood estimates of the unconstrained joint model of arbitrator decision making in conventional and final-offer arbitration. The definitions of the relevant variables are contained in table 1. All of the estimates presented in this section were derived using the optimization algorithm described by Berndt, Hall, Hall, and Hausman (1974). The estimates of the model are plausible in the sense that all of the parameters have the expected sign and are asymptotically significantly different from zero at conventional levels. The general framework of the conventional arbitration award process is supported by the data.[31] The weight on Y_{ec} relative to the offers (γ) is large so that the arbitrator pays primary attention to the facts, but the weight <u>is</u> sensitive to the quality of the offers in the sense that as the offers get

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30. Estimation of fixed effects in the fully general model would require the estimation of an additional 126 parameters in a single model. The computational burden proved to be excessive. Constrained model #2 also required the estimation of 126 extra parameters, but the estimation could be split into two pieces.

31. Bazerman and Farber (in press) discuss a similar set of estimates in detail with regard to their implications for arbitrator behavior in conventional arbitration.

farther apart the weight on Y_{ec} increases (γ_1>0). The weight on the management offer relative to the union offer is significantly larger than .5.[32]

The estimates of β_c and β_f are very similar so that their qualitative properties can be discussed without making any distinction. The differential between wages negotiated by workers in comparable situations and the present wage (COMP) has a large positive effect on Y_e. The differential between wages in the local (occupationally defined) and national (industrially defined) labor markets and the present wage (LW and NW respectively) have positive but smaller statistically significant effects on Y_e. The effect of LW is larger than that of NW. It is interesting that the level of the present wage has a small positive coefficient, although it is not significantly different from zero at conventional levels. To the extent that this coefficient is positive, the implication is that arbitrators act not only to ratify the existing proportional wage structure but also to widen the existing differentials somewhat. Finally, the financial condition of the company has an asymmetric effect on the arbitration award. The omitted category for the dummy variables are situations where the company is in "middling" condition. If the company is in worse condition (CONDB), the arbitrators made awards which were 2 to 2-1/2 percentage points lower on average. On the other hand, if the company were in better condition, the arbitrators made awards which were about 1/2 of

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32. While there is no clear interpretation of this result, it may suggest that a richer weighting scheme is needed where not only γ but also δ depends on the quality of the offers. For example, it may be the case that δ depends on the relative distances of Y_m and Y_u from Y_e. Some alternatives were investigated, but the empirical implications of these variations are so similar to the model estimated here that it was difficult to distinguish between the different specifications with any precision. See Bazerman and Farber (in press).

a percentage point higher on average. The hypothesis that the coefficients on CONDG is of equal magnitude but opposite sign to the coefficient on CONDB can be rejected at any reasonable level of significance.[33]

The central issue is how close Y_{ec} and Y_{ef} are. The first column of table 3 contains estimates of constrained model #1 where it is assumed that $Y_{ec}=Y_{ef}$ in all respects. The specific constraints along with the log-likelihood values of the unconstrained and all of the constrained models are summarized in table 4. It is not possible to perform a classical likelihood-ratio test of constrained model #1 against the unconstrained model due to the fact that one of the constraints is that $\rho_{cf}=1$ which is on the boundary of the parameter space. Nonetheless, some feel can be gained for how well the constrained model performs by noting that the log-likelihood value for this model is 1536.6 as compared with 1617.3 in the unconstrained model.[34] The implication is that Y_{ec} and Y_{ef} differ in ways that degrade the fit of the constrained model substantially.

It is useful to examine exactly how Y_{ec} and Y_{ef} differ. One possibility is that β_f and β_c differ substantially. The last column of table 2 contains the estimated differences between β_c and β_f computed from the estimates of the unconstrained model along with their asymptotic standard errors. All of these differences are small when compared to the magnitude of the coefficients themselves. Only the coefficients of CONDB differ significantly at conventional levels, and only one other difference (CONDG) exceeds its

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33. This hypothesis is equivalent to the hypothesis the the two coefficients sum to zero. Using the coefficients from conventional arbitration this sum is -.0124 with an asymptotic standard error of .00338. A similar result is derived using the coefficients from β_f.

34. Were the likelihood-ratio test valid, the hypothesis that $Y_{ec}=Y_{ef}$ could be rejected at any reasonable level of significance.

standard error. These results suggest that individual elements of β_c and β_f do not differ significantly based on their marginal distributions. However, it is also important to examine the extent to which the joint hypothesis that $\beta_c=\beta_f$ is supported by the data. Constrained model #3, whose estimates are contained in the last columns of table 3, differs from the unconstrained model only in imposing $\beta_c=\beta_f$. A likelihood-ratio test of the hypothesis that $\beta_c=\beta_f$ suggests that the hypothesis can be rejected at the .05 level of significance but not at the .025 level.[35]

Another diagnostic calculation for examining the degree of congruence between β_f and β_c is to compute the difference between $\hat{Y}_{ef}=X\hat{\beta}_f$ and $\hat{Y}_{ec}=X\hat{\beta}_c$ for each scenario based on the estimates of β_f and β_c from the unconstrained model. Table 5 contains the estimates of $\hat{Y}_{ef}$, $\hat{Y}_{ec}$ and their difference for each of the twenty-five scenarios. The asymptotic standard errors are also presented. The results are quite clear. For only four scenarios is the difference between $\hat{Y}_{ef}$ and $\hat{Y}_{ec}$ significantly different from zero at conventional levels.[36] Overall, the evidence suggests that β_c and β_f differ to a minor and inconsequential extent.

The other way in which Y_{ec} and Y_{ef} could differ is with regard to the unobserved factors. The variance ε_c differs from the variance of ε_f by .000103 with an asymptotic standard error of .0000434 so that the hypothesis that the variances are equal can be rejected at conventional levels. At the same time a very high correlation is estimated between ε_c and ε_f. The estimate of ρ_{cf} is .818 with a very small asymptotic standard error. The

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35. The test statistic is -2(1617.3-1608.6)=17.4. This statistic is distributed as χ^2 with 8 degrees of freedom. The critical values of this distribution at the .05 and .025 levels are 15.5 and 17.5 respectively.

36. Careful examination of these four cases (4,18,19,21) did not reveal any pattern that could be viewed as a common cause of the difference.

hypothesis that ρ_{cf} equals zero can be rejected at any reasonable level of significance. Thus, the unobserved factors that affect Y_{ec} are highly correlated with the unobserved factors that affect Y_{ef}. In order to see how important this correlation is, a constrained model (#2) was estimated where β_c and β_f are allowed to differ but where ρ_{cf} and $\rho_{\mu f}$ are assumed to equal zero. These are the estimates of the separate (marginal) models of conventional and final-offer choice, and they are contained in the second and third columns of table 3. The log-likelihood of this model, which has only two constraints on the unconstrained model, is 1445.7. Thus, the constraints are soundly rejected at any reasonable level. Indeed, this model with two constraints fits the data considerably more poorly than either constrained model #1 with eleven constraints or constrained model #3 with 8 constraints. Of course, the various constrained models, whose performances are summarized in table 4, are not nested appropriately, but this comparison does suggest that the correlations between the unobserved factors are substantial.

While there is important correlation between ε_c and ε_f, this correlation is not perfect. It is not possible to test the hypothesis that $\rho_{fc}=1$ directly because of the boundary problem noted earlier, but we can pick a value somewhat less than one and test that hypothesis. For example, the hypothesis that $\rho_{fc}=.95$ can be rejected against the alternative that $\rho_{fc}<.95$ at any reasonable level of significance. Note further that constrained model #1 is nested in constrained model #3. Model #1 embodies the assumption that $\varepsilon_c=\varepsilon_f$, but in all other respects is identical to model #3. The log-likelihood value of model #1 is 1536.6 while the log-likelhood value of model #3 is 1608.6. This comparison suggests that the errors are not, in fact, identical.

Overall, it is clear that the unobserved factors affecting Y_{ec} and Y_{ef} are correlated to an important extent. In addition, the observed determinants of Y_{ec} and Y_{ef} have similar effects. The ability of the model to fit the data is improved substantially by accounting for the correlation between the errors, and the performance does not degrade very much by imposing the constraint (#3) that $\beta_c=\beta_f$.

VII. Implications of the Analysis

The results presented in the previous section imply that there is a substantial amount of consistency between the decision models of arbitrators in conventional and final offer arbitration. In conventional arbitration it was argued that arbitrators make awards that are weighted averages of some notion of what is appropriate based on the facts (Y_{ec}) and the offers of the parties where the weights depend on the quality of the offers. This behavior is consistent with the arbitrator attempting to minimize a loss function that is the weighted sum of squared deviations of the award from each party's notion of an appropriate award and from the offers. In final-offer arbitration it was argued that the arbitrators choose the offer that is closest to some notion of an appropriate award based on the facts (Y_{ef}). This behavior is consistent with the arbitrator attempting to minimize a loss function that is the sum of squared deviations of the award from each party's notion of an appropriate award.

The results strongly support this framework. The conventional arbitration awards do seem to be a weighted average of the facts and the offers where the weights are dependent on the quality of the offers. In addition, the facts all influence Y_{ec} in a plausible and significant fashion. The final offer awards are determined by a comparison of the facts with the average offer, and the value of Y_{ef} that is implicit in this process is determined in plausible and significant ways by the facts. More importantly, the quantities Y_{ec} and Y_{ef} are affected virtually identically by the facts ($\beta_c=\beta_f$), and the unobserved factors affecting Y_{ec} and Y_{ef} are highly correlated. While it is not possible to conclude that the arbitrator uses exactly the same notion of an appropriate award in making decisions in both types of arbitration, the evidence is quite compelling that the arbitrators are generally consistent in their behavior.

This consistency in arbitrator's views of an "appropriate" award has a number of implications for understanding arbitration and collective bargaining. First, these results provide convincing evidence that arbitrators determine an appropriate award without reference to the particular form of arbitration in effect. The results further indicate that the appropriate award can be defined based on the facts of the case, independent both of the political and structural influences of the particular arbitration procedure and of the final offers of the parties. Next, the validity of this model of arbitrator behavior suggests a sound basis for comparing the quality of agreements under alternative forms of arbitration against an independent definition of quality. That is, the agreements reached under the threat of conventional versus final-offer arbitration (whether negotiated or arbitrated) can be compared to the appropriate award as defined by the facts of the case. While critics of conventional arbitration argue that it chills bargaining, critics of final-offer arbitration argue that it often results in unacceptable arbitration awards. The model developed and tested in this study provides a basis (the appropriate award) for judging the appropriateness of the outcomes of the two systems.

A potential reservation relates to how generalizable these results are given that they are based on awards in hypothetical cases. Of course, having actual arbitrators making the awards is an important factor militating in favor of broader applicability. In addition, the general advantages of using data from simulations are important. The facts are controlled and measured precisely, and the offers are observed even in cases of conventional arbitration. On the other hand, the simulations suffer from the fact that the situations are artificial by definition and that the arbitrator does not have the same range of information available that is available in actual cases. In sum, it is impossible to be sure that the judgments of arbitrators in simulated cases are consistent with those they would make in actual cases. Nonetheless, the internal consistency of the responses of the arbitrators across types of arbitration demonstrated in the analysis contained in this study suggests that there is a great deal of information in these simulations that can make an important contribution to understanding the behavior of arbitrators.

Another potential reservation is related to the fact that arbitrators were asked to render a final-offer judgement <u>immediately</u> after making a conventional award. This may imply that the final-offer awards are "contaminated" and the analysis will be biased in favor of finding similarities between Y_{ef} and Y_{ec}. While this might be worrisome, the advantages of this approach must be weighed against the potential problems. If in each case an arbitrator was only required to make either a conventional or a final-offer award (but not both) as specified by the investigator, only a limited version of the analysis here would be possible. It would still be possible to compare β_c and β_f, but no estimates of the correlation between the unobservables affecting Y_e in conventional and final-offer arbitration (ε_c and ε_f) would be possible. Identification of this correlation requires observation of awards in the same case by the same arbitrator for both types of arbitration.

Overall, substantial progress has been made in analyzing the decision processes of arbitrators. Not only were distinct models of arbitrator behavior in conventional and final-offer arbitration identified, but a substantial degree of underlying consistency was found in the constructs arbitrators use to make decisions in different settings. In addition, the study has demonstrated the value of using data derived from carefully designed simulations in analyzing the behavior of arbitrators. A number of areas for further research are apparent. For example, since the arbitrator decision process is likely to be central to the process of collective bargaining where arbitration is the dispute settlement mechanism, it would be useful to integrate the results of studies such as this into theoretical and empirical analysis of bargaining in an environment that includes arbitration. Finally, it is clear that arbitrators differ in their decision processes, and it would be useful to investigate both the degree to which there are such differences and how these differences affect the bargaining process.

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Table 1. Means and Standard Deviations of Data

Variable	Description (Dichotomous variables =0 otherwise)	Mean (s.d.)
PW	log of present wage	2.08 (.392)
Y_s	log diff between award and PW	.0966 (.0242)
FOA	proportion of FOA cases for Managenment	.644
INF	inflation rate	.110 (.0285)
COMP	comparable arbitrated settlements	.100 (.0281)
LW	log diff between local wage and PW	.00960 (.101)
NW	log diff between national wage and PW	.00520 (.0214)
CONDB	=1 if company in terrible or poor shape	.405
CONDG	=1 if company in good or excellent shape	.398
MFO	log diff between man. final offer and PW	.0729 (.0289)
UFO	log diff between union final offer and PW	.140 (.0282)
AFO	log diff between ave. final offer and PW	.107 (.0252)
DFO	log difference between final offers	.0673 (.0271)

N=1522

Table 2:
Estimates of Explicit Models of Arbitrator Decisions: Unconstrained Model

	Conventional	Final-offer	$\beta_c - \beta_f$
Determinants of Y_e (β)			
Constant	.0263 (.00575)	.0300 (.00755)	-.00368 (.00690)
INF	.194 (.0243)	.218 (.0311)	-.0241 (.0298)
COMP	.434 (.0225)	.416 (.0341)	.0180 (.0329)
LW	.0246 (.00650)	.0291 (.00822)	-.00455 (.00799)
NW	.266 (.0311)	.279 (.0504)	-.0134 (.0477)
PW	.00308 (.00191)	.00328 (.00256)	-.000196 (.00241)
CONDB	-.0190 (.00182)	-.0256 (.00280)	.00660 (.00246)
CONDG	.00664 (.00184)	.00370 (.00224)	.00294 (.00190)
Weight on Y_e (γ)			
γ_0	.750 (.0515)	----	
γ_1	1.69 (.673)	----	
Relative weight on the management offer			
δ	.673 (.0441)	----	
Covariance matrix			
σ^2_ϵ	.000449 (.0000229)	.000346 (.0000412)	
σ^2_μ	.00000898 (.00000372)	----	
$\rho_{\mu\epsilon}$	.0107 (.127)	-.421 (.155)	
ρ_{cf}	.818 (.0329)	----	
ln(L)	1617.3		

Note: The numbers in parentheses are asymptotic standard errors. ρ_{cf} is the correlation between ϵ_c and ϵ_f. $\rho_{\mu\epsilon}$ refers to the correlation between μ and either ϵ_c or ϵ_f, depending on the column. N=1522

Table 3:
Estimates of Explicit Models of Arbitrator Decisions: Constrained Models

	Constrained #1		Constrained #2		Constrained #3	
	CONV	FOA	CONV	FOA	CONV	FOA
Determinants of Y_e (β)						
Constant	.0280 (.00538		.0273 (.00554)	.0279 (.00812)	.0277 (.00543)	
INF	.196 (.0226)		.189 (.0234)	.237 (.0342)	.201 (.0228)	
COMP	.425 (.0212)		.422 (.0216)	.448 (.0411)	.430 (.0214)	
LW	.0256 (.00617)		.0231 (.00623)	.0391 (.00947)	.0260 (.00604)	
NW	.239 (.0294)		.286 (.0298)	.268 (.0605)	.263 (.0296)	
PW	.00334 (.00179)		.00318 (.00186)	.00179 (.00279)	.00308 (.00180)	
CONDB	-.0214 (.00172)		-.0186 (.00173)	-.0274 (.00342)	-.0212 (.00175)	
CONDG	.00620 (.00174)		.00624 (.00175)	.00370 (.00245)	.00574 (.00175)	
Weight on Y_e (γ)						
γ_0	.276 (.0974)		.827 (.0352)	----	.741 (.0504)	
γ_1	5.28 (1.11)		1.47 (.433)	----	1.53 (.603)	
Relative weight on the management offer						
δ	.588 (.0200)		.618 (.0615)	----	.703 (.0372)	
Covariance matrix						
σ^2_ε	.000404 (.0000188)		.000426 (.0000192)	.000362 (.0000556)	.000449 (.0000228)	.000344 (.0000243)
σ^2_μ	.000113 (.00000470)		.00000151 (.000000825)	----	.0000114 (.00000395)	----
$\rho_{\mu\varepsilon}$	-.223 (.0408)		.270 (.164)	0	.0593 (.114)	-.408 (.157)
ρ_{cf}	1		0	----	.825 (.0364)	----
ln(L)	1536.6		1445.7		1608.6	

Note: The numbers in parentheses are asymptotic standard errors. ρ_{cf} is the correlation between ε_c and ε_f. $\rho_{\mu\varepsilon}$ refers to the correlation between μ and either ε_c or ε_f, depending on the column. N=1522

Table 4.
Summary of Model Performance

MODEL	CONSTRAINTS	# OF PARMS	LOG L
unconstrained	----	25	1617.3
constrained #1	$\beta_c=\beta_c$ $\rho_{cf}=1$, $\rho_{c\mu}=\rho_{f\mu}$, $\sigma_c^2=\sigma_f^2$	14	1536.6
constrained #2	$\rho_{cf}=\rho_{f\mu}=0$	23	1445.7
constrained #3	$\beta_c=\beta_f$	17	1608.6

Table 5: Predicted values of Y_{ec}, Y_{ef} and their Differences for Each Scenario

Case	$\hat{Y}_{ef}$	$\hat{Y}_{ec}$	$(\hat{Y}_{ef} - \hat{Y}_{ec})$	Case	$\hat{Y}_{ef}$	$\hat{Y}_{ec}$	$(\hat{Y}_{ef} - \hat{Y}_{ec})$
1	.0922 (.00166)	.0931 (.00138)	-.000935 (.00155)	14	.0938 (.00242)	.0942 (.00173)	-.000413 (.00239)
2	.0569 (.00269)	.0595 (.00160)	-.00260 (.00272)	15	.0988 (.00242)	.101 (.00150)	-.00207 (.00210)
3	.0623 (.00200)	.0652 (.00143)	-.00291 (.00207)	16	.0865 (.00229)	.0835 (.00179)	.00299 (.00212)
4	.122 (.00213)	.116 (.00191)	.00564 (.00181)	17	.0604 (.00330)	.0611 (.00197)	-.000762 (.00324)
5	.0996 (.00225)	.101 (.00202)	-.00117 (.00196)	18	.0868 (.00248)	.0819 (.00189)	.00490 (.00210)
6	.0946 (.00209)	.0926 (.00157)	.00194 (.00215)	19	.0791 (.00256)	.0740 (.00190)	.00509 (.00212)
7	.0789 (.00335)	.0793 (.00192)	-.000421 (.00335)	20	.113 (.00233)	.111 (.00170)	.00224 (.00231)
8	.124 (.00225)	.124 (.00165)	.000750 (.00202)	21	.115 (.00246)	.109 (.00203)	.00592 (.00207)
9	.0989 (.00204)	.0973 (.00164)	.00153 (.00213)	22	.116 (.00239)	.114 (.00181)	.00180 (.00225)
10	.0932 (.00307)	.0950 (.00148)	-.00174 (.00285)	23	.123 (.00257)	.121 (.00175)	.00156 (.00249)
11	.117 (.00243)	.113 (.00200)	.00369 (.00224)	24	.0891 (.00276)	.0868 (.00176)	.00228 (.00278)
12	.0765 (.00451)	.0764 (.00225)	.0000704 (.00459)	25	.119 (.00263)	.114 (.00175)	.00420 (.00272)
13	.0888 (.00267)	.0893 (.00176)	-.000473 (.00259)	AVE.	.0954 (.00101)	.0942 (.000667)	.00124 (.00104)

Computed from the estimates of β_f and β_c for the unconstrained model whose estimates are in table 2. The numbers in parentheses are asymptotic standard errors.