On the Selection of Arbitrators

Online Appendix

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1 Agencies Following the Rank-Veto Procedure

Agency	Link	Section
FMCS	http://www.fmcs.gov/internet_text_only/itemDetail.asp?categoryID=197&itemID=16959	1404.12 (c)
AAA	http://www.adr.org/sp.asp?id=22440#R11	R-11 (b)
AIRROC	http://www.airroc.org/drp/default.aspx?file=THE.AIRROC.DISPUTE.RESOLUTION.PROCEDURE.pdf	3
CBAAS	https://www.cincybar.org/arbitration_Rules.asp	VI.
Hong Kong Construction Association	http://www.hkca.com.hk/upload/files/0100015727.pdf	Appendix 3: 2.7
State of New Hampshire	http://www.nh.gov/pelrb/forms/documents/arbitration.pdf	4

2 Empirical Analysis of New Jersey data

2.1 Are Preferences Perfectly Opposed?

The question of designing an appropriate selection procedure is relevant only if preferences are *not* strictly opposed. Otherwise, the VR mechanism is a simple zero-sum game, and all its Nash equilibria are reasonable. So is it the case that parties have strictly opposed preferences? As explained in the Introduction, there are reasons to believe otherwise. Beyond intuition, this section presents an empirical test showing that preferences are not always opposed.

We use information from the New Jersey Public Employment Relations Commission (PERC). During the years 1985 to 1996, employers and unions were provided a menu of seven arbitrators and were asked to veto three arbitrators and to rank the remaining four.[1] The arbitrator with the lowest combined rank among those that were not vetoed by either party was then

[1] After 1996, the an arbitrator is randomly selected by a computer from the list of approved arbitrators.

chosen as the arbitrator for the case. This mechanism thus corresponds to the VR mechanism described in the Introduction, with $n = 7$.

Data on rankings by employers and unions cover the years 1985 to 1996. Variables in this dataset include the year of the case, the names of the two parties (employer and union), the menu of arbitrators (including first and last name), the rankings of each party, and the name of the arbitrator chosen by the procedure. Employers in these data are local governments within the state of New Jersey.[2] We drop a number of cases with inconsistent or incomplete data.[3] After deleting these observations, we are left with 750 cases with complete rankings by employers and employees and in which the chosen arbitrator followed the rankings submitted by the two parties. Given that the menu includes seven arbitrators, we thus have 5,250 arbitrator choices and 10,500 unique ranks, one for the employer and one for the union.

When preferences are perfectly opposed, truthful behavior is a Nash equilibrium. Moreover, truthful play may be considered the focal equilibrium in this case. Thus, if preferences were perfectly opposed, then there should be no overlap in terms of either the rankings or the vetoes.

	U1	**U2**	**U3**	**U4**	**U veto**
E1	17%	13%	15%	12%	14%
E2	15%	16%	15%	13%	14%
E3	15%	14%	13%	14%	15%
E4	11%	15%	13%	16%	15%
E veto	42%	42%	43%	46%	42%

Table 1: Conditional Distribution of Employer (E) and Union (U) Rankings of Arbitrators

To examine this issue empirically, Table 1 presents the conditional distribution of rankings of arbitrators between the employer (E) and the union (U). For example, conditional on an arbitrator being ranked first by the union, this arbitrator is also ranked first by the employer in 17 percent of cases, ranked

[2]These include municipalities, such as the city of Trenton, agencies within municipal governments, such as corrections in Middlesex County, and agencies within the state government, such as the New Jersey State Police. Unions represented are then public sector unions within the relevant government or government agency.

[3]Examples of cases with inconsistent or incomplete data include some cases in which the arbitrator chosen does not reflect the mechanism described above, cases in which one or both of the two parties did not submit a ranking, and cases in which parties submitted rankings but did not follow the request to veto three options and rank the remaining four.

second in 15 percent of cases, ranked third in 15 percent of cases, ranked fourth in 11 percent of cases, and vetoed in 42 percent of cases. Under truthful play with perfectly opposed preferences, the arbitrators ranked first, second, and third by the union would always be vetoed by the employer, and the median arbitrator for both sides would be ranked fourth and would be the one chosen in equilibrium. The pattern observed in this table, however, is quite different, with a nearly uniform distribution across these categories. Thus, the empirical distribution of rankings is inconsistent with perfect opposition.

One limitation of this test involves multiplicity of equilibria. In particular, when preferences are perfectly opposed, parties always veto their bottom $(n-1)/2$ ranked options in equilibrium but any ranking of the remaining $(n+1)/2$ options constitutes a Nash equilibrium. Indeed, we will see in our experimental analysis to follow that subject pairs are truthful in only 25% of cases when preferences are completely opposed, and this is due mainly to deviations from sincerity on the ranking of the non-vetoed options.

number of common vetoes	frequency
0	13%
1	50%
2	34%
3	3%

Table 2: Overlap in vetoes

To address this issue, we next develop a more robust test based upon the fact that, as noted above, there should be no overlap in vetoes when preferences are perfectly opposed. To address this issue empirically, Table 2 displays the frequency of the number of overlap in vetoes, which can equal zero, one, two, or three. To be clear, in Table 2, the complete ranking profile is the unit of observation, whereas, in Table 1, the arbitrator is the unit of observation. As shown, we find a substantial degree of overlap in vetoes. In particular, in 50% of cases there is one common veto, in 34% of cases there are two common vetoes, and in 3% of cases there are three common vetoes. That is, in 87% of the cases the parties' vetoes overlap, and there is no overlap in only 13% of cases. Taken together, these tests find little evidence that preferences are perfectly opposed.

2.2 Empirical Test of Strategic Play

Our test of strategic play exploits the panel aspect of the data from the New Jersey Public Employment Relations Commission (PERC), as described in

Section 2, and involves an analysis of pairwise reversals in rankings. If an employer, for example, ranks arbitrator a over b in one case but arbitrator b over a in another case, we infer that, under an assumption of stable preferences, these rankings do not reflect the preferences of the employer and hence that the employer was strategic.

As should be clear, this test requires an assumption of complete information, as maintained above, and an additional assumption of stable employer preferences for a given employer across cases. Under this assumption, if the same pair of arbitrators appears in two different cases, then one should always be ranked above the other by non-strategic players with the same preferences. Pairwise reversals in rankings would thus provide evidence of strategic behavior.

This test is aided by the fact that the same arbitrators appear repeatedly in the data. Given that employers occur in multiple cases more commonly than do unions, we focus our analysis on comparing employer rankings of arbitrator pairs across multiple cases. Based upon these repeated occurrences of arbitrators and employers, we found 447 observations in which an employer had the same two arbitrators in the choice set in two different arbitration cases and in which the two sets of rankings can be compared.[4]

One reason that the assumption of stable preferences might be violated involves learning by employers about the desirability of different arbitrators. We address this issue by excluding observations in which one of the arbitrators was assigned to the employer in the period between the two cases. In these situations, it is reasonable to assume that the employer learns something, such as the tendency of this arbitrator to side with the employer, from this experience. Such learning could potentially change the employer's preferences over arbitrators in the context of future cases. Of the original sample of 447 observations, we find that one of the arbitrators was assigned to the employer in 198 observations in the period between the two cases.[5] Excluding these 198 observations, we have 249 observations in which the employer had no interaction with the two arbitrators during the period between the two cases. In these cases, we do not expect employers to learn something about the arbitrator, and we thus assume that employer preferences over arbitrators are stable in these cases.

[4]If both arbitrators are vetoed in one (or both) of the two cases, we cannot determine the relative ranking of these two options in that case, and these observations thus excluded from the analysis.

[5]This could be due to the arbitrator being selected in the first of the two cases or in a separate case during the intervening time period.

	consistent	reversal
no experience	66.27%	33.73%
experience	56.06%	43.94%

Table 3: Pairwise reversal of employer rankings by experience with arbitrator

As shown In Table 3, of these 249 observations, the relative rankings of the two arbitrators switches in around one-third (34 percent) of the observations. The relative rankings of the two arbitrators is unchanged/consistent in the other two-thirds (66 percent) of the observations. This finding of a substantial number of reversals is inconsistent with sincere rankings under the assumption of stable preferences and suggests that there is some element of strategic play involved in these rankings.

As noted above, this analysis excludes the observations in which the employer had some experience with the arbitrator during the period between the two cases. For comparison purposes, we next present results for this set of observations. As shown, among the 198 observations with interactions during the time period between the two cases, we see a somewhat higher switching rate (44 percent versus 34 percent), and this difference of 10 percentage points between these two types of cases is statistically significant at the 95-percent level. This finding of a higher switching rate when the employer had an interaction with the arbitrator is consistent with employers learning from working with specific arbitrators.

As noted above, this test of pairwise reversals requires an assumption of stable preferences in the two cases. To shed light on the validity of this assumption, we next use information on the time that elapsed between the two cases. It is reasonable to assume that if preferences are not stable, then more switching in rankings should occur as the time that elapsed between the two cases increases.

years between cases	consistent	reversal
0	83.02%	16.98%
1	67.57%	32.43%
2	64.44%	35.56%
3	57.69%	42.31%
4	60.61%	39.39%
5	62.50%	37.50%
6	61.54%	38.46%
7	60.00%	40.00%

Table 4: Pairwise reversal of employer rankings by experience with arbitrator

As shown in Table 4, which focuses on the subset of cases in which the employer had no interaction with either of the two arbitrators under consideration in the period between the two cases, switching rates are increasing as the number of years between the two cases increases. In particular, if the cases occur during the same year, then reversals occur in around 17 percent of cases. This rate increases to 32 percent if there is one year between the two cases and to 36 percent if there are two years between the two cases. Beyond two years, the reversal rates stabilize at around 40 percent.[6]

This finding of an increase in reversal rates as the elapsed time increases suggests that the assumption of stable preferences is questionable. On the other hand, there are still a sizeable fraction of switches, 17 percent, when the two cases occur during the same year. It seems unlikely that preferences would change during the same year, especially given that the employer has no interaction with the arbitrators in these cases. Thus, while we find some evidence that preferences are not stable, we continue to see instances of switching in cases where the assumption of stability is most plausible. Thus, any possible instability in preferences cannot entirely explain the finding of a substantial number of switches.

[6]While there could be up to 11 years between the two cases, the number of observations is too small to conduct a meaningful analysis when the number of years between the two cases exceeds seven.

3 Instructions for the Experiment (VR)

This is an experiment in interactive decision-making. By participating in this experiment, you will win a show-up bonus of $10 plus a prize that depends upon the choices that you and other participants make.

The experiment consists of 40 rounds. In each round the computer will randomly match you to another participant and both of you will play the game described below. The outcome of this game is a selection of a single option from a list of five, labeled a,b,c,d,e.

In each round, each of the five options will be assigned a dollar value. One option will be worth $1.00, a second option will be worth $0.75, a third option will be worth $0.50, a fourth option will be worth $0.25 and a fifth will be worth $0.00. At the beginning of each round, you will be told what dollar value you assign to each of the options, as well as what dollar value the other player assigns to each of the options. The table below shows a possible configuration of values for you and the other player (the values in the experiment itself) :

	You	Other Player
$1.00	d	c
$0.75	b	a
$0.50	a	e
$0.25	e	b
$0.00	c	d

Similarly, the participant you are matched with will also be shown the values that both he and you assign to each option. In other words, both you and the participant you are matched with will see the same table as the one shown above.

The 40 rounds will be divided into four stages consisting of 10 rounds each (such that stage 1 consists of rounds 1-10, stage 2 consists of rounds 11-20, stage 3 consists of rounds 21-30 and stage 4 consists of rounds 31-40). In each stage, half of the participants will be randomly chosen to belong to group A and the other half will belong to group B. The participants belonging to the same group will have the same assignment of money to options. In each of the 10 rounds of a stage, the participants of one group will be randomly matched to the participants in the other group. Thus, in each stage of 10 rounds, the values you assign to each option and the values of your matched participant will remain unchanged.

At the beginning of each stage you will be shown a message that announces the start of a new stage. This message will alert you to the fact that the values of the options for you and the other player may be different from what they were in the previous stage. As in every round, these values will be displayed on the screen.

Your total payoff in the entire experiment will equal the sum of payoffs across all 40 rounds plus a show-up bonus of $10.

Your payoff in each round will be displayed on the top right of the screen.

We now describe the rules of the game that you will play in each of the 40 rounds. These rules determine which option is selected at the end of the round.

- In each round, one of the two participants who are matched to play the game, is randomly selected to be Player 1 (the other participant is then Player 2). This means that each of the two participants has an equal chance of being selected as Player 1. This also means that each participant may be in the role of

Player 1 on some rounds and in the role of Player 2 on other rounds.

- The game proceeds in two steps
  - Step 1: Player 1 moves first and selects a shortlist of three distinct options out of a,b,c,d,e.
  - Step 2: Player 2 is informed of Player 1's shortlist, and chooses the final option out of it.

To illustrate these rules, here is a simple example.

Suppose that in a particular round with payoffs as listed in the table above, you have been selected to be Player 1, while the other participant you are matched with had been selected to be Player 2. Suppose that the following actions have been chosen

- Player 1 (You) moves first and selects the shortlist a, c, d.
- Player 2 (the other participant you are matched with) moves second and chooses c out of a, c, d.

This round thus ends with c being selected. You thus receive a payoff of $0 for this round, while the participant you are matched with receives a payoff of $1.

Quiz:
To confirm whether you understood the rules of the game, please answer the following question.
Assume that the values you assign to each option are as follows:

	You
$1.00	c
$0.75	e
$0.50	d
$0.25	b
$0.00	a

Question 1. Suppose that in a particular round, players choose the following actions.

- Player 1 moves first and selects the shortlist a, c, e.
- Player 2 moves second and selects c out of the shortlist a, c, e.

(**a**) Which option will be selected?

- a
- b
- c
- d
- e

(**b**) What will your payoff be?

- $1.00
- $0.75
- $0.50
- $0.25
- $0.00

Question 2. Suppose that in a particular round, the participant you are matched was selected to be Player 1, and selected the shortlist b, d, e.

(**a**) Suppose that you selected the option d out of the shortlist. What will your payoff be?

- $1.00
- $0.75
- $0.50
- $0.25
- $0.00

(**b**) Suppose that you selected the option e out of the shortlist. What will your payoff be?

- $1.00
- $0.75
- $0.50
- $0.25
- $0.00

Click to send your answers to the quiz

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4 Instructions for the Experiment (SL)

This is an experiment in interactive decision-making. By participating in this experiment, you will win a show-up bonus of $10 plus a prize that depends upon the choices that you and other participants make.

The experiment consists of 40 rounds. In each round the computer will randomly match you to another participant and both of you will play the game described below. The outcome of this game is a selection of a single option from a list of five, labeled a,b,c,d,e.

In each round, each of the five options will be assigned a dollar value. One option will be worth $1.00, a second option will be worth $0.75, a third option will be worth $0.50, a fourth option will be worth $0.25 and a fifth will be worth $0.00. At the beginning of each round, you will be told what dollar value you assign to each of the options, as well as what dollar value the other player assigns to each of the options. The table below shows a possible configuration of values for you and the other player (the values in the experiment itself) :

	You	Other Player
$1.00	d	c
$0.75	b	a
$0.50	a	e
$0.25	e	b
$0.00	c	d

Similarly, the participant you are matched with will also be shown the values that both he and you assign to each option. In other words, both you and the participant you are matched with will see the same table as the one shown above.

The 40 rounds will be divided into four stages consisting of 10 rounds each (such that stage 1 consists of rounds 1-10, stage 2 consists of rounds 11-20, stage 3 consists of rounds 21-30 and stage 4 consists of rounds 31-40). In each stage, half of the participants will be randomly chosen to belong to group A and the other half will belong to group B. The participants belonging to the same group will have the same assignment of money to options. In each of the 10 rounds of a stage, the participants of one group will be randomly matched to the participants in the other group. Thus, in each stage of 10 rounds, the values you assign to each option and the values of your matched participant will remain unchanged.

At the beginning of each stage you will be shown a message that announces the start of a new stage. This message will alert you to the fact that the values of the options for you and the other player may be different from what they were in the previous stage. As in every round, these values will be displayed on the screen.

Your total payoff in the entire experiment will equal the sum of payoffs across all 40 rounds plus a show-up bonus of $10.

Your payoff in each round will be displayed on the top right of the screen.

We now describe the rules of the game that you will play in each of the 40 rounds. These rules determine which option is selected at the end of the round.

- In each round, one of the two participants who are matched to play the game, is randomly selected to be Player 1 (the other participant is then Player 2). This means that each of the two participants has an equal chance of being selected as Player 1. This also means that each participant may be in the role of

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$1.00	c
$0.75	e
$0.50	d
$0.25	b
$0.00	a

Question 1. Suppose that in a particular round, players choose the following actions.

- Player 1 moves first and selects the shortlist a, c, e.
- Player 2 moves second and selects c out of the shortlist a, c, e.

(**a**) Which option will be selected?

- a
- b
- c
- d
- e

(**b**) What will your payoff be?

- $1.00
- $0.75
- $0.50
- $0.25
- $0.00

Question 2. Suppose that in a particular round, the participant you are matched was selected to be Player 1, and selected the shortlist b, d, e.

(**a**) Suppose that you selected the option d out of the shortlist. What will your payoff be?

- $1.00
- $0.75
- $0.50
- $0.25
- $0.00

(**b**) Suppose that you selected the option e out of the shortlist. What will your payoff be?

- $1.00
- $0.75
- $0.50
- $0.25
- $0.00

Click to send your answers to the quiz

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5 Observed Outcomes

Profile	Procedure		**a**	**b**	**c**	**d**	**e**	**ab**	**ac**	**bc**	**abc**	**other**
Pf1	VR	early	.07	.09	.54	.08	.06	.02	.01	.02	.00	.10
		late	.03	.05	.87	.01	.01	.00	.01	.01	.01	.02
		pooled	**.05**	**.07**	**.70**	**.05**	**.03**	**.01**	**.01**	**.02**	**.00**	**.06**
	SL	early	.05	.06	.79	.07	.04					
		late	.03	.03	.87	.05	.03					
		pooled	**.04**	**.04**	**.83**	**.06**	**.03**					
Pf2	VR	early	.24	.47	.02	.01	.01	.20	.02	.00	.03	.01
		late	.19	.43	.05	.03	.00	.23	.02	.03	.02	.01
		pooled	**.21**	**.45**	**.03**	**.02**	**.00**	**.21**	**.02**	**.01**	**.03**	**.01**
	SL	early	.50	.48	.03	.00	.00					
		late	.46	.51	.01	.02	.00					
		pooled	**.48**	**.50**	**.02**	**.01**	**.00**					
Pf3	VR	early	.08	.38	.11	.06	.03	.10	.00	.11	.11	.01
		late	.16	.38	.11	.08	.04	.07	.00	.03	.11	.01
		pooled	**.12**	**.38**	**.11**	**.07**	**.03**	**.08**	**.00**	**.07**	**.11**	**.01**
	SL	early	.25	.31	.35	.10	.00					
		late	.41	.25	.23	.10	.02					
		pooled	**.32**	**.28**	**.29**	**.10**	**.01**					
Pf4	VR	early	.37	.08	.30	.07	.01	.01	.10	.04	.01	.02
		late	.41	.12	.18	.06	.02	.02	.12	.03	.01	.04
		pooled	**.39**	**.10**	**.24**	**.06**	**.01**	**.01**	**.11**	**.03**	**.01**	**.03**
	SL	early	.40	.04	.45	.06	.07					
		late	.48	.02	.46	.04	.00					
		pooled	**.45**	**.03**	**.45**	**.05**	**.03**					