Wages and Arbitrator Behavior

Janet Currie

University of California, Los Angeles

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Abstract

The basic assumption of the model of arbitrator behavior developed in this paper is that arbitrators weight the information they receive in exactly the same way as it has been weighted in recent negotiated settlements. This model has several testable implications. First, arbitrated and negotiated settlements should not differ within or between jurisdictions, if the observable characteristics of the districts do not vary greatly. Second, one can improve the fit of an equation for arbitrated settlements by including the expected value of the errors from an equation for negotiated wages. Finally, standard errors from the equation for arbitrated wages should be smaller than those from a corresponding equation for negotiated wages. The model is tested using a sample of 1650 contracts covering public school teachers in the Canadian province of British Columbia over the period 1960 to 1981. All of its predictions are supported by these data.

Introduction

An unresolved dispute imposes costs on any two parties who have made specific investments in an ongoing relationship. But breakdowns in collective bargaining in the public sector frequently impose costs on third parties. Hence the state often intervenes in these disputes, by forbidding public-sector strikes and substituting compulsory binding interest arbitration. Under interest arbitration, a neutral third party decides the terms and conditions of the new contract.[1] Half of the American states and all of the Canadian provinces now have interest arbitration statutes covering some groups of public employees.

An impediment to the more widespread use of interest arbitration in the public sector is a perception on the part of policy makers that arbitration raises wages. For example, the California Tax Payers Association Research Bulletin (1983 pg. 5) states unequivocally that "arbitration raises wages".

The question of what effect arbitration has on wages has not yet been resolved. In an early study of this issue, Auld, Christofides, Swindinsky and Wilton (1979) found that arbitrated settlements "bear no resemblance to freely bargained wage outcomes".[2] Other studies find no difference between arbitrated and negotiated settlements within a jurisdiction, although average wages appear to be higher in jurisdictions with arbitration than in those with neither arbitration nor the right to strike. It is difficult to draw any inference about the

effect of arbitration on wages from this latter observation because as Ehrenberg and Schwartz (1986) suggest, high wage states may also be more likely to adopt arbitration statutes.

The starting point for this study is the observation that the effect of arbitration on wages will depend on the behavior of arbitrators. To take a simple example, if arbitrators were known to be biased in favor of labor, then one would expect both arbitrated and negotiated settlements to rise with the imposition of compulsory arbitration (Farber and Katz, 1979).

However, the design of arbitration systems makes it unlikely that arbitrators with obvious biases will be selected, since an important feature of interest arbitration is that the parties have a say in the selection of their "judge". They may alternate in striking names off a list for instance, or they may rank-order names. Any arbitrator who is known to be biased toward one party will be unacceptable to the other.

Arbitrators can avoid the suspicion of bias by adopting rules which make them statistically exchangeable: That is, rules which ensure that any two arbitrators given the same set of facts will arrive at (roughly) the same award. Ashenfelter (1987) discusses the empirical evidence that arbitrators are statistically exchangeable. One rule which satisfies this criterion is for arbitrators to weight the information they observe in exactly the same way as it has been weighted in recent negotiated settlements.

In this paper several implications of this simple model of

arbitrator behavior are derived and tested using a sample of 1650 contracts covering public school teachers in the Canadian province of British Columbia over the period 1960 to 1981. I find strong support for the model.

The rest of the paper is laid out as follows: Section 1 presents the testable implications of the model. The data are discussed in section 2. Tests of the model are presented in section 3. A comparison of teacher wages across provinces is in section 4. A potential problem with simple rules of arbitrator behavior is that they not only make it easy for arbitrators to coordinate -- they also make it possible for parties who understand the rules to manipulate arbitral awards to their own advantage. Evidence that parties learned to manipulate the system in British Columbia is discussed in section 5. Conclusions are presented in section 6.

1. Testable Implications of the Model

The two major forms of interest arbitration are conventional arbitration and final-offer arbitration. The difference is that under conventional arbitration, the arbitrator may impose any award whereas in final-offer arbitration, both parties make simultaneous offers and the arbitrator chooses one.

Many empirical studies of arbitration assume that under both types of arbitration, the arbitrator's preferred settlement, y_a, is a weighted average of y', the average of the employer and the union's offers, and of $y^*(x)$, a settlement that depends on the observable facts of the case denoted, $\mathbf{x}$.[3] Hence,

(1) $y_a = ay' + (1-a)y^*(x)$.

It is usually assumed that under conventional arbitration the arbitrator's preferred award, y_a, becomes the settlement. Under final-offer arbitration, the final offer closest to the preferred award is chosen. Gibbons (1987) derives a decision rule of this form as the equilibria of models of both conventional and final-offer arbitration. Following Gibbons, I assume that the arbitrator is able to use the average offer, y', to infer the parties' private information about what he calls the "state of the employment relationship", **s**. In what follows, a subscript **n** or **a** indicates a variable pertaining to a negotiated or arbitrated settlement respectively.

To complete the model, we must indicate how the function y^* and the weighting factor **a** are chosen. Assume that negotiated settlements are given by

(2) $y_n = s_nB_1 + x_nB_2 + u_n$

where u_n is a white noise error term with variance S^2. I assume that s_n is revealed in the course of negotiations and thus is observable by arbitrators. Arbitrators form estimates of B_1 and B_2 and use these to determine their preferred settlements, so that

(3) $y_a = s_ab_1 + x_ab_2$

where $b_i = B_i + v_i$, and $i = 1, 2,$ and $E(v_i)=0$. This equation is analogous to equation (1) since y' is replaced by s_a and y^* by x_a. Equation (3) can be rewritten as,

(4) $y_a = s_aB_1 + x_aB_2 + u_a$

where $u_a = (s_a v_1 + x_a v_2)$. If arbitrators form unbiased estimates of B_1 and B_2, then apart from variations in **x** and **s**, the expected value of arbitrated and negotiated settlements will be the same.

It will be assumed throughout that arbitrators observe s_n and are able to infer s_a through observing the average offer of the parties. However, the econometrician is in a less fortunate position -- data about the state of the employment relationship are generally unavailable, or only imperfectly proxied by available data. Models which can be estimated from the observable data by least squares are:

(5) $y_n = x_n b_{2n} + e_n$

and

(6) $y_a = x_a b_{2a} + e_a$

Using the formula for a partitioned matrix it is easy to show that $e_n = M_n[s_n B_1 + u_n]$ where $M_j = [I - x_j(x_j'x_j)^{-1}x_j]$, and j= n, a. Similarly, $e_a = M_a[s_a B_1 + u_a]$.

Suppose now that an econometrician estimates (5) and (6) using a sample such that

A1: $(x_n'x_n)^{-1}x_n's_n = (x_a'x_a)^{-1}x_a's_a$

and

A2: $M_n s_n = M_a s_a = Q$

These conditions imply that if one were able to do a regression of the unobservable on the observable variables, one would obtain the same slope coefficients and the same residuals whether one used the arbitrated or negotiated settlements. An example of a set of data which would satisfy these restrictions would be one

in which bargaining units with arbitrated and negotiated settlements had the same observable characteristics, and unobservable state variables that differed only by a constant term.

While these are no doubt strong assumptions, they can be used to illustrate a number of relationships that will hold if the relationship between observables and unobservables is similar for both arbitrated and negotiated settlements.

First, under A2, $E(e_a) = E(e_n)$ so that if a measure of the latter were available it could be used to improve on the fit of model (6) above.

Second, $Var(e_n) = S^2M_n$ while under A2, $Var(e_a) = S^2(M_a s_a[s_n'M_n s_n]^{-1} s_a M_a)$ as shown in the appendix. Hence, given A1 and A2, and the same number of negotiated and arbitrated settlements, it is straight-forward to show that $Var(e_n)$ exceeds $Var(e_a)$ by a positive semi-definite matrix, $S^2M_n[I - Q(Q'Q)^{-1}Q']$. It follows that the trace of $Var(e_n)$ exceeds that of $Var(e_a)$. This prediction will hold true if we observe only a subset of the possible arbitrated settlements, i.e. if the number of arbitrated settlements is less than the number of negotiated settlements.

These predictions are tested in the empirical work described below.

2. The Data

The data consist of twenty-two annual observations on each of seventy-five school districts in the Canadian province of British Columbia. All but a few districts with incomplete data

are included.[4] All public school teachers must belong to the British Columbia Teacher's Federation (BCTF), but each "local" bargains independently with its own school board. The BCTF supplies information and negotiating assistance if it is requested by the local teacher's organization.

Teachers have been subject to compulsory binding conventional arbitration of wage and salary disputes since 1937.[5] Under the terms of the Public School Act of 1937, negotiations between teachers and school boards followed the schedule laid out in Chart 1. The bargaining time-table was changed in 1984. By statute, contracts were renegotiated annually, and only compensation could be negotiated. Data about whether or not each contract was decided by arbitration are available from 1947. The legislation did not specify criteria for arbitral decisions, but arbitrator reports emphasized provincial and community trends and agreements in nearby districts.

It is important to note that because arbitration proceedings were automatically initiated if no agreement had been reached by November 14, all negotiated settlements for a given year were known before any arbitral settlements were decided. It is this feature of the data that will be exploited to test the model presented above.

Teachers in B.C. are divided into six pay categories depending on the number of years of post-secondary education they have received (one to six). There are no new teachers in the first two categories. Within each group, teachers with more

experience are paid more up to a maximum rate. Wage scales define a bracket for each of the six groups and the number of experience categories within each group. The number of categories ranges from eight to fourteen in each group, depending on the contract. Real wages are calculated using the Vancouver Consumer Price index as provincial price deflators are not available. The number of teachers in each category was not available, so it was not possible to compute an average wage. Instead, maximum wages for teachers with four years of post-secondary education are used as the dependent variable in the wage equations reported below. This choice was based on the fact that wage data for this group are the most complete. The use of other points on the salary scale as wage measures made little difference to the empirical results.

Wage data for each board and provincial macroeconomic data are available from the 1960's to the present. Unfortunately, the Compensation and Stabilization Act of 1982 (Bill 128) centralized control over school board budgets and drastically restricted public sector collective bargaining in B.C.[6]. I have chosen to exclude the years following 1981 from the sample. The most serious limitation of these data is the fact that I have few "x" variables. The lagged wage and a dummy variable for each bargaining unit are included in the regressions below. A second problem is that dates of settlements were not recorded. The limitations that this problem places on the analysis will become apparent in section 5. Finally, details about the arbitration

hearings such as the name of the arbitrator or the bargaining positions of the parties are not available. Data sources are listed in the data appendix.

3. Testing the Model

Table 1 examines the within-jurisdiction difference between negotiated and arbitrated wage rates in a regression framework. All the regressions reported below include dummy variables for each school board, although these coefficients are not reported in the tables. Standard errors are corrected for arbitrary heteroskedasticity using the formulas for the jackknife in MacKinnon and White (1984).

Columns (1) and (2) show ordinary least squares (OLS) and two-stage least squares (2SLS) estimates from the regression of real wages on lagged wages, a dummy variable equal to one if the settlement was decided by arbitration, and dummy variables for each year. The 2SLS estimates allow for possible simultaneity between the decision to use arbitration and the wage settlement. Three lags of the arbitration dummy are used as instruments for the arbitration dummy, and overidentifying restrictions on these instruments are not rejected. The arbitration variables are not statistically significant in either equation, which indicates that, in keeping with other studies, arbitrated and negotiated wages do not differ within British Columbia.[7]

The year dummies used in models (1) and (2) perfectly control for all year-to-year changes in the economic environment, but do not have a ready economic interpretation. Columns (3) and

(4) show regressions which correspond to (1) and (2) except that year dummies have been replaced by macroeconomic and demographic variables as well as by the total number of settlements decided by arbitration in each year. Included macroeconomic variables which may affect wage settlements are average weekly wages and salaries in the province, the provincial unemployment rate, and the Vancouver consumer price index (CPI). Demographic variables include numbers of children younger than ten and numbers of children greater than ten but less than nineteen years old. Lagged values of the independent variables are used because the wage in effect in year t was decided in year t-1.

These equations do not fit as well as those including year dummies, but the hypothesis that arbitrated wages differ significantly from negotiated ones is still rejected. The estimated coefficients on the macroeconomic and demographic variables indicate that controlling for the lagged wage, real teacher wages are predominantly counter-cyclical, and they vary positively with the number of school age children. The CPI is statistically significantly negative which reflects the fact that contracts are imperfectly indexed.

Column (3) suggests that although the settlement in a particular board is not affected by whether or not arbitration was used, the average settlement is slightly lower in years when there were many arbitrations. This result disappears in the 2SLS regression, but the standard errors from 2SLS are sufficiently large that the null hypothesis that the coefficients on the total

number of arbitrations were the same in columns (3) and (4) cannot be rejected.

In order to test the model, the equations shown in Table 1 were estimated separately for arbitrated and negotiated settlements. The results, which are quite similar to those shown in Table 1 , are displayed in Table 2.

Under A1, it should be possible to improve the fit of the equation describing arbitrated settlements by including a measure of $E(e_n)$. The reason is that $E(e_n)$ can be used to infer information about the missing variable s_a. Since negotiated settlements in a given year precede arbitrated ones, a natural measure of $E(e_n)$ is the mean residual for each year from the regression shown in column (2). Column (5) shows that including these residuals in the model for arbitrated wages results in a significant improvement in the fit of the equation for arbitrated wages. The estimated coefficient is positive which implies that shocks to a given year's negotiated wages are reflected in that year's arbitral decisions.

To the extent that negotiated wages are a good proxy for $E(e_n)$, their inclusion in the model should also improve the fit of equation (4). Column (6) shows that this hypothesis is borne out by the data but that the improvement in fit is much less dramatic than when estimates of $E(e_n)$ itself are included.

Table 2 also shows that, as predicted by the model, the standard errors of the corresponding equations for negotiated wages are greater than those of the equations describing

arbitrated wages. This comparison is extended in Table 3, where the standard errors from equations (2) and (4) are shown for each year. In fifteen out of twenty years, the standard errors from the equation for negotiated wages are greater than those from the equation for arbitrated wages. The difference is statistically significant at the 95% level of confidence in eight years. An (unreported) comparison of the standard errors from equations (1) and (3) which included lagged wages and year dummies produced even sharper results.[8]

Table 3 also shows a steady decline in the standard errors associated with the equation for arbitrated settlements from the early sixties to the early seventies, which suggests that the decisions of arbitrators became more easily predictable over the period. Not surprisingly, the errors from the equation for the negotiated settlements follow the same pattern: as the probable outcome of arbitration becomes more certain, the range of possible negotiated settlements becomes narrower. These findings are consistent with Gunderson's (1983) claim that the introduction of arbitration tends to reduces wage dispersion.

In summary, the implications of the model presented in section 2 are supported by the data: Within British Columbia, arbitrated settlements are similar to negotiated settlements; including $E(e_n)$ improves the fit of an equation for arbitrated wages; and the standard errors from an equation for arbitrated wages are smaller than those from a corresponding equation for negotiated wages.

4. Wage Differences Across Jurisdictions

If arbitrated settlements follow negotiated ones rather than vice versa as the error variances suggest, then it is difficult to see how the introduction of arbitration per se could raise wages. Table 4 addresses the question of whether or not the existence of arbitration has effected the average level of teacher wages in the British Columbia.

The table shows the ratio of maximum weekly teacher salaries in B.C., Ontario and Alberta to average weekly wages and salaries in the three provinces. Maximum salaries are paid to teachers with six years of post-secondary education and ten years of experience. This group was chosen for the comparison because only maximum salaries were available for Ontario.

Ontario and Alberta are the two other Canadian provinces in which teacher-school board bargaining takes place on a local school board level. Teachers in Alberta have the right to strike, while those in Ontario may choose either the strike or arbitration. Comparing these ratios controls for teacher quality and for inter-provincial differences in average wage rates.

The table shows that although the maximum teacher salaries are higher in B.C. than in Alberta or Ontario, the ratio of top teacher salaries to average salaries is very similar in B.C. and Alberta, but higher in Ontario. On the whole, relative wages appear to be similar in jurisdictions with arbitration and those with the right to strike.

5. Arbitrator Behavior and the Evolution of an Arbitration System Over Time.

The percent of contracts decided by arbitration in each year from 1947 to 1981 and its three year moving average are graphed in Plots 1 and 2. The number of bargaining units using arbitration ranged from a low of two in 1962 and 1971 to a high of 58 in 1976. On average, one third of all negotiations ended in arbitration. This average did not change over time, but during the 1970's the variance in the number of arbitrations increased and a pattern of a year with few arbitrations followed by a year with many arbitrations emerged. This two-year pattern is puzzling given the statutory contract length of one year.

Currie (1989) was unable to explain these sharp swings in the number of arbitrations using levels or coefficients of variation of macroeconomic or demographic variables, or changes in the legislation governing collective bargaining in the province.[9] However, the three year moving average of the percentage of contracts arbitrated was shown to be pro-cyclical and varied positively with the number of school age children. Currie (1988) also shows that large numbers of past arbitrations have no effect on the end period wages of individual bargaining units.

These facts suggest that the average level of arbitration activity is related to economic conditions, but that the exact timing and location of arbitrations reflects other considerations. In this section, I argue that the model

described above provides a possible explanation for two characteristics of the pattern in the number of arbitrations over time. The first is the large changes in the number of arbitrations from one year to another, and the second is the two-year cycle in these swings. Unfortunately, the fact that the settlement dates are not observed will make it difficult to test the hypotheses advanced below.

If the parties understand the way in which arbitral decisions are made, they can manipulate the system to their own advantage. For example, suppose a few unusually low wage settlements are negotiated early in the year. Then the mean of e_n computed over these settlements is negative, so that if arbitrators base their decisions on these cases, they will make low awards. If employers act strategically and employees do not, then all remaining employers have an incentive to refuse to bargain in order to ensure that the contract goes to arbitration.[10]

On the other hand, if there is nothing unusual about the first few contracts to be negotiated, the probability that subsequent negotiated contracts will make it worthwhile for employers to stonewall decreases as the number of contracts negotiated increases.

Given the incentive structure facing the employer, it is possible that small deviations in the first few negotiated settlements from their expected values could lead to large changes in the number of arbitrations per year. The fact that

there is no one district that always bargains first makes it more plausible that such deviations could occur.[11]

I have couched this story in terms of the employer acting strategically while the union does not because wages are lower in years with large numbers of arbitrations. The correlation between the standard errors of the negotiated settlements and the number of negotiated settlements is -.242 (with standard error equal .179) -- which suggests that employers are more likely to act strategically then employees. In British Columbia, school boards are often represented in negotiations by officials who have acted in that capacity for many years, while teachers tend to be represented by negotiators drawn from their own ranks who change over frequently.[12] Thus, school boards may be in a better position to take advantage of arbitrator behavior than teachers are.

Note that if employees were also to act strategically, then employers would be able to extract concessionary terms from employees in these years without both parties incurring the expense of arbitration and we would not see large swings in the number of arbitrations per year.

It is possible that arbitrator behavior is also responsible for the two-year cycles in the number of arbitrations. Suppose that arbitrators were concerned by the public's perception that arbitrated settlements deviate systematically from negotiated ones. They might respond by compensating in year t+1 for the difference between mean arbitrated and negotiated settlements in

year t. Parties would take this response into account when deciding whether or not to use arbitration.

For example, suppose that early negotiated settlements in year t are unusually low, and that therefore many employers find it to their advantage to use arbitration in year t. The mean arbitrated settlement for year t will then be low. The low year t wages will tend to depress negotiated wages in t+1 because wages are highly correlated over time, but employers will be less likely to take advantage of the situation because they realize that the arbitrators will compensate for the low year t settlements with higher settlements in t+1.

In order to test this hypothesis about arbitrator behavior, the difference between mean arbitrated and negotiated settlements was included in models similar to columns (2) and (4) of Table 3. The results are shown in Table 5, columns (1) and (3). The coefficient on the difference term is statistically significantly negative. As predicted, high arbitrated settlements in year t are associated with lower arbitrated settlements in year t+1.

As noted above, the two-year pattern in the number of arbitrations did not appear before the 1970's. One possible explanation is that decline in the risk associated with arbitration, as measured by the error variances, encouraged risk averse parties to try their luck going to arbitration. A second possible explanation is that it simply took the parties many years to learn the rules governing arbitrator behavior.
A third possibility is that the rules themselves have changed

over time. For example, arbitrators may not at first have compensated for high or low arbitrated settlements in the previous year.

In order to see whether the rules have changed over time, the difference between mean arbitrated and negotiated settlements was interacted with a dummy variable equal to one if the year was less than 1970 and a dummy equal to one if the year was greater than or equal to 1970. The results of including these two variables in models corresponding to Table 3, columns (2) and (4) are shown in Table 5, columns (2) and (4). The difference between mean arbitrated and negotiated settlements only becomes statistically significant in the 1970's, the same period for which we see two-year cycles in the number of arbitrations.

6. Summary and Conclusions

The model tested in this paper starts with the assumption that arbitrators adopt rules which make them statistically exchangeable. The specific rule assumed here is that arbitrators weight the information they receive in exactly the same way as it has been weighted in recent negotiated settlements. An important auxiliary assumption is that variables the econometrician does not observe are related to the observable variables in the same way whether the contract was negotiated or not.

This model has several testable implications. First, arbitrated and negotiated settlements should not differ within a jurisdiction, if the observable characteristics of the districts

do not vary greatly. Second, one can improve the fit of an equation for arbitrated settlements by including the expected value of the errors from an equation for negotiated wages. Intuitively, the errors from the latter provide information about unobservables which have been omitted from the equation for arbitrated wages. Finally, standard errors from the equation for arbitrated wages should be smaller than those from a corresponding equation for negotiated wages. All these predictions are supported by the data.

The model also implies that the introduction of arbitration per se should not cause wage rates to differ from what they would otherwise have been. The limited amount of inter-provincial data that is available supports this claim.

In light of the model, a possible explanation for the two-year cycles in the number of arbitrations observed in these data is that knowing the rules governing arbitrator behavior, each party attempts to manipulate the system to its own advantage. The rigid bargaining timetables which are common in jurisdictions with compulsory interest arbitration probably exacerbate this problem. Some evidence was presented that arbitrators in British Columbia have changed their rules over time, in an effort to make such manipulations more difficult.

1. In contrast, under grievance arbitration, the arbitrator interprets the provisions of an existing contract.

2. Auld et al. run separate equations for arbitrated and negotiated settlements and find that the coefficients on the independent variables differ. A possible explanation is that bargaining units covered by arbitration legislation differ from those who are not along dimensions not captured in their estimating equations.

3. A decision rule of this form appears as equation (12) in Ashenfelter and Bloom (1984), equation (3) in Farber and Bazerman (1986) and equation (1b) in Bloom (1986).

4. Eight boards which merged with a larger one in the early seventies have been omitted. For details see Currie (1989). Three very small boards were also omitted because wage data were not available.

5. Teachers are the only provincial group specifically covered by arbitration legislation. Other public servants have been subject to a succession of essential services laws which allow the government to intervene in labor disputes on an ad hoc basis.

6. The events that followed passage of Bill 128 cannot be analyzed in purely economic terms. An example of the degree of political interference in the collective bargaining process was the replacement of the elected Vancouver school board when it refused to submit a budget within the new provincial guidelines in 1982.

7. Currie (1989) shows that wages are not statistically significant in logits for the probability of arbitration either.

8. The standard errors from the equation for negotiated wages exceed those from the arbitrated wages for every year except 1978. The difference was statistically significant at the 95% level of confidence in eleven years.

9. In addition to using levels of the variables used in this paper, Currie looked at correlations between the number of arbitrations and levels of nominal B.C. GDP and B.C. average wages, the percent of provincial negotiations ending in strikes, and mean real teacher wages, as well as coefficients of variation of the B.C. help wanted index, the Canadian unemployment rate, B.C. employment, B.C. average wages, the Canadian CPI, and real teacher wages. She also attempted to explain the spikes in the number of arbitrations using changes in the provincial labor code.

10. There is some anecdotal evidence in support of the view that bargainers act strategically in this way. According to Richard Lester of the Princeton Industrial Relations section, one

attorney who represents municipalities in police/firefighter arbitrations sequences the cases so that lowest wage cases are first in order to drive down the subsequent settlements.

11. According to Mark Thompson of the University of British Columbia's School of Industrial Relations, school districts do not tend to reach settlements in any particular order, although both parties pay close attention to recently negotiated settlements.

12. Data about who represented each side in each negotiation is not available. The view of the bargaining parties expressed here is based on correspondence with individual school boards, and with the British Columbia Teacher's Federation.

Chart 1

Negotiation Timelines for B.C. Teachers*

Sept. 20	Notice to negotiate must be given
Sept. 30	Negotiations must begin
Oct. 15	Conciliator appointed
Nov. 14	Dispute must go to an arbitration board
Nov. 27	Teachers and school boards must chose their representatives on the arbitration board
Dec. 2	Chairman of the arbitration board must be agreed upon by the teacher and board appointees
Dec. 7	Minister of Labour choses the chair if no agreement reached
Dec. 31	If no decision has been reached by the board the chair is given the authority to decide the settlement
Jan. 5	Decision must be made by the chair

* From Marcotte(1980)

Table 1: Log Real Wage Equations 1962-1981

Independent Variables	(1) OLS	(2) 2SLS[a]	(3) OLS	(4) 2SLS
Log Lagged Wage	.699* (.035)[b]	.686* (.040)	.601* (.035)	.601* (.099)
Arbitration Dummy	.0002 (.0007)	-.029 (.025)	.0000 (.0009)	-.137 (.089)
Log Total # Arbitrations	--	--	-.0044* (.0004)	.025 (.019)
Year Dummies	Yes	Yes	No	No
Log Lagged B. C. Average Wage	--	--	-.211 (.026)	-.272 (.120)
Lagged .0018* Vancouver CPI (.0007)	--	--	-.0013* (.0001)	
Lagged BC Unemployment (.0049) Rate	--	--	-.0035* (.0005)	.0033
Log Lagged # Children 0-9	--	--	.111* (.030)	.190 (.133)
Log Lagged # Children 10-19	--	-- (.019)	.343* (.066)	.392*
Intercept	2.81 (.331)	2.95 (.381)	2.22 (.214)	1.79 (.805)
Standard Error	.0107	.0161	.0136	.0593
Degrees of Freedom	1379	1379	1392	1392

Notes:

[a] Instruments include 3 lags of the arbitration dummy and the other exogenous variables. The three lags account for about 6% of the variation in the dummy variable for arbitation.

[b] Standard errors corrected using the Jackknife.

Table 2: Wage Equations Separately for Arbitrated and Negotiated Settlements, 1962-81.

Independent Variables	Negotiated (1)	Negotiated (2)	Negotiated (3)	Arbitrated (4)	Arbitrated (5)	Arbitrated (6)
Log Lagged Wage	.677 (.047)[a]	.622 (.046)	.727 (.046)	.570* (.070)	.694* (.048)	.571* (.065)
Log Total # Arbitrations	--	-.0044* (.0005)	--	-.0035 (.0019)	.0067* (.0010)	-.0062* (.0017)
Year Dummies	Yes	No	Yes	No	No	No
Log Lagged BC Avg. Wage	--	-.198* (.044)	--	-.186* (.035)	-.257* (.024)	-.134* (.031)
Lagged Vancouver CPI	--	-.0012* (.0002)	--	-.0010* (.0002)	-.0016* (.0001)	-.0009* (.0002)
Lagged BC Unemp Rate	--	-.0042* (.0006)	--	.0005 (.0013)	-.0054* (.0009)	-.0025* (.0011)
Log Lag # Children 0-9	--	.061 (.040)	--	.247* (.063)	.063 (.037)	.160* (.049)
Log Lag # Children 10-19	--	.341* (.024)	--	.298* (.046)	.307* (.028)	-.015 (.059)
Mean Error From Neg Wage Equation Current Year	--	--	--	--	1.08* (.050)	--
Mean Negotiated Wages Current Year	--	--	--	--	--	.494* (.066)
Intercept	3.03 (.439)	2.29 (.284)	2.56 (.432)	1.79 (.423)	2.15 (.292)	-.662 (.519)
Degrees of Freedom	848	861	438	451	450	450
Standard Error	.0120	.0142	.0075	.0118	.0081	.0109

Notes:

[a] Standard errors corrected using the Jackknife.

Table 3: Standard Errors and Mean Real Wages for Each Year from Equations (2) and (4) of Table 2.

	(1) Arbitrated Settlements			(2) Negotiated Settlements			
Year	Mean Wage[a]	Standard Error	#	Mean Wage	Standard Error	#	F test[b]
1962	8.3	.0275	2	8.5	.0158	71	.167
1963	8.6	.0163	13	8.7	.0147	60	.760
1964	8.9	.0113	18	8.9	.0138	55	1.43
1965	9.2	.0116	34	9.3	.0175	39	2.28*
1966	9.7	.0141	17	9.6	.0135	56	.876
1967	9.9	.0087	25	10.4	.0095	48	1.15
1968	10.3	.0107	21	10.2	.0177	53	2.67*
1969	10.6	.0130	26	10.5	.0113	48	.744
1970	10.9	.0082	48	10.9	.0085	26	1.07
1971	11.9	.0080	2	11.3	.0097	72	.752
1972	11.4	.0050	48	11.5	.0076	26	2.34*
1973	11.8	.0144	37	11.8	.0190	37	1.73*
1974	11.7	.0146	49	11.8	.0220	25	2.30*
1975	12.4	.0204	6	12.3	.0088	68	.157
1976	12.2	.0094	57	12.6	.0194	17	4.51*
1977	12.5	.0095	34	12.3	.0121	40	1.62
1978	12.7	.0113	11	12.5	.0145	63	1.51
1979	12.0	.0048	45	12.3	.0120	29	6.42*
1980	12.0	.0075	23	12.8	.0113	51	2.27*
1981	11.9	.0103	16	12.0	.0110	58	1.06
Overall:		.0118			.0142		1.44*

Notes:
[a] In thousands of real dollars.
[b] F test for H0: $Var_n = Var_a$ vs. HA: $Var_n > Var_a$. A * indicates that the difference is significant at the 95% level of confidence.

Table 4

Ratio of Average Nominal Maximum Teacher Salaries to Average Salaries in British Columbia, Ontario and Alberta

	Average Maximum Wage			Teacher-Province Ratio		
Year	BC	Ontario	Alberta	BC	Ontario	Alberta
1972	15427	.	11212	1.87	.	1.48
1973	16795	.	15292	1.88	.	1.90
1974	18605	.	16646	1.86	.	1.86
1975	21553	.	21553	1.87	.	1.91
1976	23654	22384	21939	1.82	1.96	1.85
1977	25466	25466	24375	1.79	1.95	1.81
1978	26949	26036	25303	1.79	1.97	1.83
1979	29016	27701	27909	1.77	1.94	1.82
1980	31773	29736	29965	1.75	1.91	1.75
1981	35782	32336	34142	1.76	1.86	1.75
Average Ratio (1976-81):				1.78	1.93	1.80

Notes:

BC teacher salary data are from the British Columbia Teacher's Federation. Ontario salary data are from the Education Relations Commission. Alberta data are from the Canadian Collective Bargaining Review and covers about seventy percent of Alberta teachers, since bargaining units with less than 500 employees are not covered by the CBR. Average weekly salary data for each year and province are taken from the Cansim University Base and multiplied by 50 to get an estimate of yearly salaries. In Ontario, teacher contracts run from Sept. to Sept. In the table, salaries for the 1975 to 1976 school year are counted as 1976 salaries, etc. In Ontario and B.C., actual salaries are available for each year. In Alberta, only the salaries negotiated in each contract were available. If the contract ran for more than 16 months, the salary was counted as the salary for the second year of the contract. Teacher salaries are not weighted by size of bargaining unit.

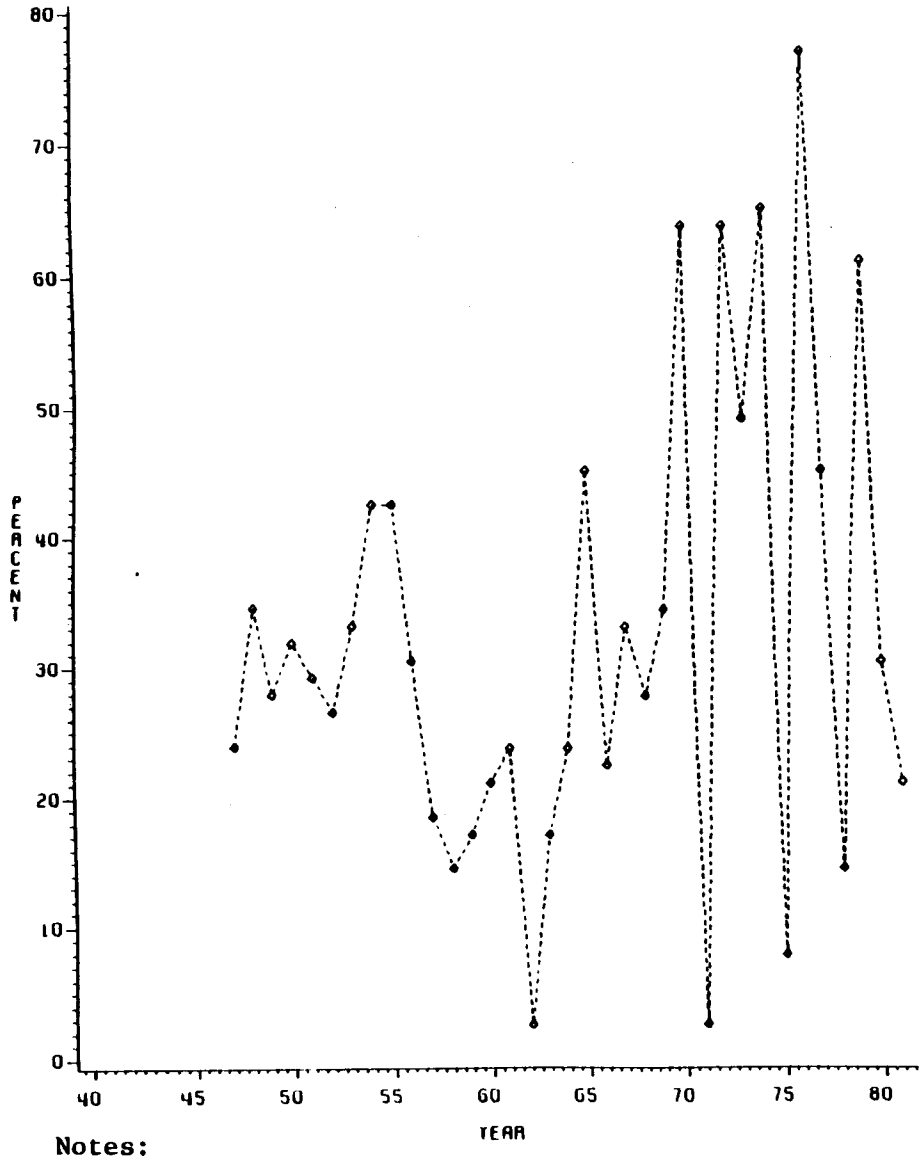
Table 5: Wage Equations for Arbitrated and Negotiated Settlements Including the Difference Between Mean Arbitrated & Mean Negotiated Settlements Last Year, 1962-81.

Independent Variables	Negotiated (1)	Negotiated (2)	Arbitrated (3)	Arbitrated (4)
Log Lagged Wage	.627* (.046)[a]	.628* (.046)	.581* (.068)	.583* (.069)
Log Total # Arbitrations	-.0044* (.0005)	-.0048* (.0006)	-.0019 (.0023)	-.0019 (.0023)
Year Dummies	No	No	No	No
Log Lagged BC Avg. Wage	-.123 (.049)	-.063 (.054)	-.129* (.041)	-.123* (.042)
Lagged Vancouver CPI	-.0009* (.0003)	-.0006* (.0003)	-.0007* (.0002)	-.0007* (.0002)
Lagged BC Unemp Rate	-.0037* (.0006)	-.0039* (.0006)	.0018 (.0014)	.0018 (.0014)
Log Lag # Children 0-9	.068 (.039)	-.0016 (.047)	.315* (.071)	.304* (.074)
Log Lag # Children 10-19	.322* (.025)	.296 (.025)	.269* (.050)	.264* (.051)
Log Lagged Difference mean Arbitrated and Negotiated Settlements	-.201* (.044)	--	-.178* (.044)	--
Log Lagged Difference *Dummy for Year Greater Than 1970	--	-.291* (.048)	--	-.184* (.044)
Log Lagged Difference *Dummy for Year Less Than 1960	--	.141 (.100)	--	-.101 (.146)
Intercept	1.90 (.304)	2.13 (.312)	1.13 (.516)	1.18 (.517)
Degrees of Freedom	860	859	450	449
Standard Error	.0140	.0139	.0115	.0115

Notes: [a] Standard errors corrected using the Jackknife.

Plot 1

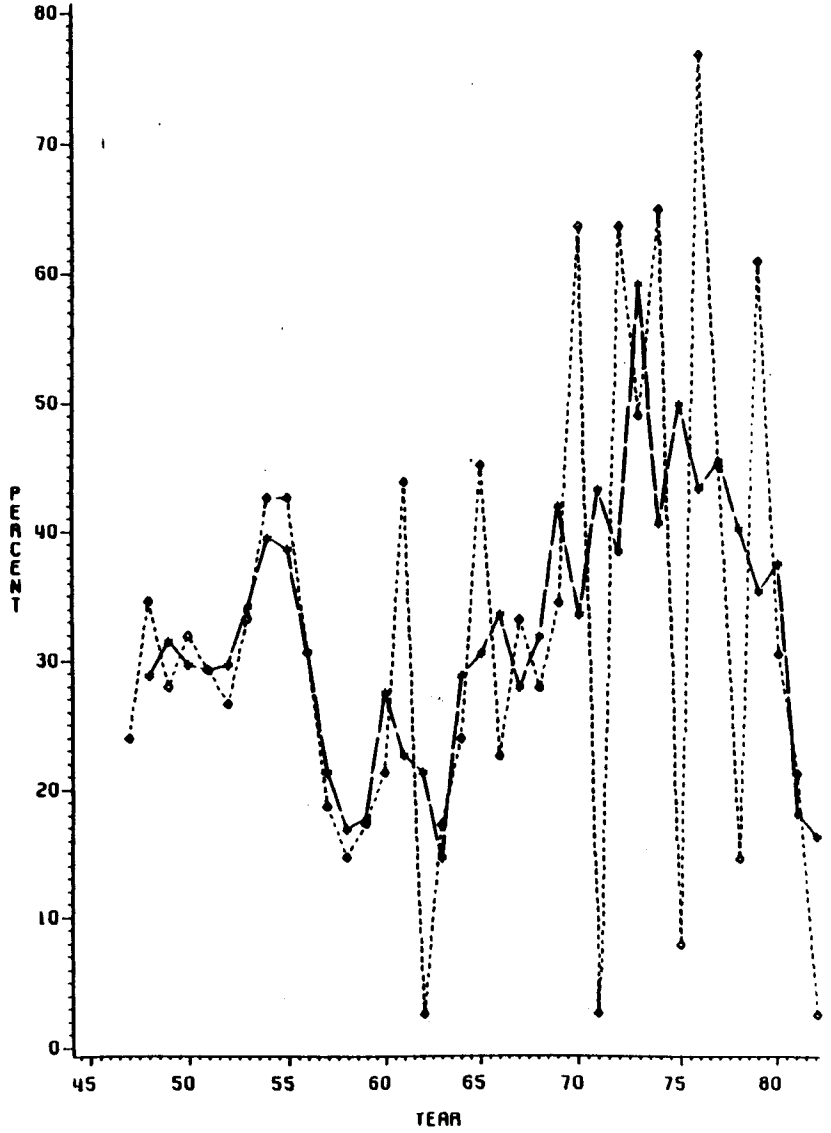
PERCENT OF TEACHER-BOARD NEGOTIATIONS GOING TO ARBITRATION
1947-1981



Notes:
The plot shows the percent of this year's contracts that were decided by arbitration. The actual arbitrations take place in the last quarter of the year preceding the contract. Important events over the period which may have had an impact on arbitration rates include the introduction of a new Labour Code in 1972, the Anti-Inflation Board (1975-1977), and a new Essential Services Disputes

Plot 2

TEACHER ARBITRATIONS: RAW AND THREE YEAR MOVING AVERAGE
DIAMOND=RAW
STAR=SMOOTHED



Notes:
The raw series is the percent of teacher-board negotiations going to arbitration from Plot 1. The smoothed series is the three year moving average of the percent arbitration series from Plot 1.

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Data Appendix

Data Description	Source	Period[a]
Whether or not each board used arbitration in each year for 75 boards	British Columbia Teacher's Federation	47-81 annual
Salary grids. Minimum and maximum salaries for each of 6 teacher grades, and number of increments	BCTF	60-82 annual
Duration of negotiations, size, stage settled, min/max salary for some teacher grades for > than 500 employees	Collective Bargaining Review (monthly)	72-82 annual
B.C. Unemployment Rate[b]	Labour Force Survey Division, Statistics Canada	46-65 annual
B.C. Unemployment Rate[c]	CANSIM 1984 D769170	66-82 monthly
Population by four age groups (0-4, 5-9, 10-14, 15-19) and sex	CANSIM 1984 D125470-3 D125490-3	51-82 annual
Vancouver Consumer Price Index[d]	Prices Division Statistics Canada	40-82 annual
Average Weekly Wage and Salaries, B.C.	CANSIM 1984 D5246	53-84 monthly
Contract data including negotiated wage, union affiliation, length of negotiations, stage of settlement, COLA information for > 500 employees	Labour Canada tape	65-82 for each contract

Notes:

[a]Monthly series were converted to annual by averaging.
[b]Unemployment rate for 14 years and up.
[c]Unemployment rate for 15 years and up. The labour force survey definition of unemployment was changed in 1966.
[d]The treatment of shelter in the regional CPI was changed in 1978 and series were only revised back to 1971. I use the old definition of the CPI, which has been extended forward by Statistics Canada on an unofficial basis.

Appendix

This appendix demonstrates that $Var(\hat{e}_n)$ exceeds $Var(\hat{e}_a)$ by a positive semi-definite matrix.

Given:

$$(1) \qquad y_n = S_n B_1 + X_n B_2 + u_n$$

where $u_n \sim (0, 0^2)$ and

$$(2) \qquad y_a = S_a b_1 + X_a b_2 + u_a$$

where $b_i = B_i + V_i$, $i = 1,2$, $E(V_i) = 0$, then

$$(3) \qquad y_a = S_a B_1 + X_a B_2 + u_a$$

where $u_a = S_a V_1 + X_a V_2$.

Using the formula for partitioned matrices it is easily shown that

$$(4) \qquad b_1 = (S_n' M_n S_n)^{-1} S_n' [I - S_n' X_n (X_n' X_n)^{-1} X_n'] y_n$$

$$= B_1 + (S_n' M_n S_n)^{-1} S_n' M_n u_n$$

and

$$(5) \qquad b_2 = [-(X_n' X_n)^{-1} (X_n' S_n) (S_n' M_n S_n)^{-1} S_n'$$

$$+ (X_n' X_n)^{-1} (X_n' + (X_n' S_n) (S_n' M_n S_n)^{-1} S_n' X_n (X_n' X_n)^{-1}) X_n'] y_n$$

$$= B_2 + (X_n' X_n)^{-1} X_n' [u_n - S_n (S_n' M_n S_n)^{-1} S_n' M_n u_n]$$

where $M_n = (I - X_n (X_n' X_n)^{-1} X_n')$

Now assume that instead of (1) and (2) we estimate

$$(6) \qquad y_n = X_n b_{2n} + e_n$$

and

$$(7) \qquad y_a = X_a b_{2a} + e_a$$

then $\hat{e}_n = y_n - X_n B_{zn}$

$$= M_n y_n$$

$$= M_n(S_n B_1 + u_n)$$

$$\therefore E(\hat{e}_n) = M_n S_n B_1$$

$$Var(\hat{e}_n) = E((\hat{e}_n - E(\hat{e}_n))(\hat{e}_n - E(\hat{e}_n))')$$

$$= E(M_n u_n u_n' M_n)$$

$$= \sigma^2 M_n$$

$$\hat{e}_a = y_a - X_a y_a$$

$$= M_a(S_a B_1 + u_a)$$

$$= M_a \{S_a B_1 + S_a(S_n' M_n S_n)^{-1} S_n' M_n u_n + X_a(X_n' X_n)^{-1} X_n' u_n$$

$$- X_a(X_n' X_n)^{-1} X_n' S_n (S_n' M_n S_n)^{-1} S_n' M_n u_n\}$$

which implies

$$\hat{e}_a = S_a B_1 + S_a(S_n' M_n S_n)^{-1} S_n' M_n u_n - X_a(X_a' X_a)^{-1} X_a' S_a B_1 \tag{8}$$

$$- X_n(X_a' X_a)^{-1} X_a' S_a (S_n' M_n S_n)^{-1} S_n' M_n u_n$$

Note that $E(\hat{e}_a) = M_a s_a B_1$ without imposing any simplifying assumptions.

Under A1

$$(X_a' X_a)^{-1} X_a' S_a = (X_n' X_n)^{-1} X_n' S_n$$

and (8) reduces to

$$\hat{e}_a = M_a S_a B_1 + M_a S_a (S_n' M_n S_n)^{-1} S_n' M_n u_n$$

Hence $$Var(\hat{e}_a) = E((\hat{e}_a - E(\hat{e}_a))(\hat{e}_a - E(\hat{e}_a))')$$

$$= E[M_a S_a (S_n' M_n S_n)^{-1} S_a' M_n u_n u_n' M_n S_n (S_n' M_n S_n)^{-1} S_a' M_a]$$

which implies

$$Var(\hat{e}_a) = \sigma^2 (M_a S_a (S_n' M_n S_n)^{-1} S_a' M_a) \tag{9}$$

Under A2 $M_a S_a = M_n S_n = Q$. Then:

$$\mathrm{Var}(\hat{e}_n) - \mathrm{Var}(\hat{e}_a) =$$

$$\sigma^2[M_n - M_a S_a (S_n' M_n S_n)^{-1} S_a M_a]$$

$$= \sigma^2 M_n [I - M_n S_n (S_n' M_n S_n)^{-1} S_n' M_n]$$

$$= \sigma^2 M_n [I - Q(Q'Q)^{-1} Q']$$

which is positive semidefinite.