TRANSACTION COSTS, LABOR MARKET INSTITUTIONS, AND STRIKES

by

Ignace Ng

B.A. (79), M.A. (81), Simon Fraser University.

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Name: Ignace Ng (Yin Ping)

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Examining Committee:

Chairman: Kenji Okuda

Dennis Maki
Senior Supervisor

Ken Strand

Peter Kennedy

Robert Swidinsky
External Examiner
Professor of Economics
University of Guelph

Date Approved: June 28, 1985

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Transaction Costs, Labor Market Institutions and Strikes

Author:

(signature)

Ignace Ng (Yin Ping)

(name)

June 28, 1985

(date)

ABSTRACT

The purpose of this paper is to develop a model of strike incidence and to empirically test the proposed model using a sample of 1264 expired bargaining contracts from 19 2-digit SIC manufacturing industries.

In this analysis, the negotiation process and the strike mechanism are viewed as alternatives through which unionized bargaining pairs can search for a contract. A strike will occur if both parties perceive that the strike mechanism entails a lower cost in reaching a settlement than the cost under the negotiation option. This depends upon the existence of post contractual opportunistic behavior, the parties' strike costs per unit of time, and the "stake" in the strike.

The dependent variable in the estimating strike equation is a dummy variable, and the testing procedure includes both logit and probit analyses. Regarding the independent variables, a number of proxies are used, and they are wildcat strikes, size of the bargaining unit, relative value added, intra year variations in shipments and in inventories of finished goods, and an index measuring the ability of the parties to forecast the total mandays lost due to workstoppages.

The empirical results provide strong support for the hypotheses advanced in the proposed model. Further, these results also suggest that the procyclical movement of strike activity is not a mistake. Instead, it is the result of rational responses by the bargaining parties.

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I. Introduction

This paper presents a theory of strikes arising from bargaining between management and labor over the terms to be contained in a collective bargaining contract. In any theory of strikes, there are two basic issues that need to be explained. First, given that a strike is not expected to occur in the absence of conflict between the bargaining parties, any explanation of strike activity must therefore provide an explanation of why conflict is present in the first place. Second and perhaps more important, any theory purporting to explain the occurrence of a strike must also provide a rationale as to why both sides at the bargaining table prefer the strike mechanism over the (pure) negotiation process[1]. It is not sufficient to explain why one side wants to strike because its opponent can always agree to its demand, thereby precluding the occurrence of a strike.

A survey of the literature on strike incidence suggests that the majority of the existing studies can, at best, account for only one of these two issues. Accordingly, the purpose of this paper is to develop an explanation of strike incidence which can satisfactorily answer both questions.

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[1]The (pure) negotiation process is here defined as bargaining in the absence of workstoppage while the strike mechanism involves bargaining with workstoppage. In this sense, both the negotiation process and the strike mechanism are bargaining tools that the parties have at their disposals.

The proposed model is based upon insights gained from studies on property rights, transaction costs and out-of-court settlements. It shows that conflict is inherent in the employer-employee relationship because of the lack of well-defined property rights on the extra output resulting from team production. Further, in this model, the strike mechanism is viewed as one of the many labor market institutional arrangements developed to help the parties search for a contract. That is, instead of considering the occurrence of a strike as a mistake, the proposed model is of the view that the strike mechanism serves the basic function of speeding up the concession rates of the parties and hence helps the parties reach a settlement. In this framework, a strike will therefore occur if both parties perceive that the total cost of reaching a settlement under a strike option is less than the total cost under other alternatives[2]. Our hypothesis is that this depends upon the 'stake' in the strike, the prevalence of post contractual opportunistic behavior and the magnitude of the joint strike cost per unit of time.

For empirical purposes, data on 1264 individual bargaining contracts across 19 2-digit (CIC) Canadian manufacturing industries are used. The dependent variable is a dummy variable which takes on the value of 1 if during contract negotiation, the bargaining parties adopted the strike mechanism as a means

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[2]These total costs include all expenses incurred starting from the expiry date to the day an agreement is reached.

to settlement. Because of the 0-1 value of the dependent variable, the testing procedure includes both the logit and the probit models. The explanatory variables in the strike equation are: wildcat strikes, size of the bargaining unit, relative value added, forecast error of mandays lost due to work stoppages, and intrayear variations in shipments and in inventories.

Following this section, the next section presents a survey of existing strike studies. In section III, the discussions presented in the literature survey are integrated into a unified framework, and in section IV, the proposed strike model is developed. Section V deals with the empirical analysis, and section VI explains the data measurements. In section VII, the testing procedures are discussed. Section VIII provides the empirical results, and in section IX, some concluding remarks are made.

II. Literature Survey

The question of why a strike occurs has been examined in a number of disciplines including economics, sociology, political science and history. For our purpose, we shall focus primarily on those studies relating strikes to the economic environment, with only a brief discussion of the 'noneconomic' studies. Further, the survey is limited to those studies explaining the incidence of contract-renewal strikes[1],which for the period 1970-1979 accounted for about 88.3% of the total person-days lost due to industrial conflict in Canada (Anderson and Gunderson, 1982. Page 226). In addition, no attempt will be made to differentiate among the various measures of strike activity such as number of strikes, mandays lost, and duration of strikes.

The studies surveyed are classified into five categories - the empirical models, the bargaining models, the mistake models, the one party models, and the joint models. These categories are by no means mutually exclusive but we feel that they provide a clear perspective on the existing strike studies.

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[1]In addition to contract-renewal strikes, there are strikes arising during the term of a contract, and strikes arising from the negotiation of the first contract.

The Empirical Studies.

Within this category, we include those studies which are mainly empirical in nature. Their theoretical foundation are usually based upon an integration of the various theories of strike causation, and the primary objective of these studies is to examine which economic and noneconomic variables influence the level of strike activity. The main contribution of these studies is from an empirical perspective, ranging from the use of more refined data bases to the use of more advanced economic testing procedures.

Until recently, the majority of these empirical studies were concerned with the relationship between business cycles and the time pattern of aggregate strike activity. A positive relationship between business cycles and the level of strike activity is expected, and this a priori expectation is often based upon strike theories developed by Rees (1952), Ashenfelter and Johnson (1970), and so on. In general, these empirical studies (Griffen, 1939; Hansen, 1921; Weintraub, 1966) found a positive correlation between strike activity and the business cycle. This relationship is also found in the more contemporary studies (Shalev, 1980; Smith, 1972 and 1976; Vanderkamp, 1970), which on the basis of regression analyses estimated a negative sign on the unemployment variable (or its proxies) in the strike equation[2].

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[2]Exception to this evidence includes the studies by Cousineau and Lacroix (1976) and Walsh (1975). They obtained a positive relationship between the number of strikes and the unemployment proxy. Scully (1971), using spectral analysis, also rejected the

In addition, the more contemporary studies have also incorporated other economic variables such as inflation and money wages in their strike equation. The estimated results seem to support the view that inflation increases the level of strike activity, while the evidence on the relationship between money wages and strike activity is inconclusive. Cousineau and Lacroix (1976) found the latter relationship to be statistically insignificant, Vanderkamp (1970) found a significant and positive relationship while Walsh (1975) found a significant and negative relationship.

With the availability of better data bases, there has also been a growing number of ad hoc empirical studies attempting to explain strike activity across cities (Stern, 1976), industries (Creigh and Makeham, 1980; Jones and Walsh, 1984; Shorey, 1975 and 1976), states (Burton and Krider, 1975), unions (Roomkin, 1976), and collective agreements (Swindinsky and Vanderkamp, 1981).

Just as with the time series studies mentioned earlier, these cross section (or pooled-cross section) studies have no particular theoretical foundation. The explanatory variables included in their strike equations are based upon previous

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[2](cont'd) hypothesis that there is an association between strikes and business activity. A plausible explanation for these conflicting results is that the procyclical movement of strikes is in fact an empirical issue since at the peak of the cycle, the aggressiveness of the union may be offset by the flexibility of the firm (Cousineau and Lacroix, 1976). Thus, whether a strike occurs depends upon the extent of these offsetting factors.

empirical studies and upon research in the fields of psychology and political science. These variables can be broadly divided into two groups. First, we have those factors such as the unemployment rate (Burton and Krider, 1975), nominal wages (Jones and Walsh, 1984) and other economic variables which describe the general economic environment within which the units of observation (for example, cities, collective agreements, industries, states, and unions) operate. The second set of factors can be viewed as the noneconomic determinants of strike activity, and they include factors which define the existing political environment, community and population characteristics, historical forces, and the internal characteristics of the unit of observation[3].

It should be obvious that when dealing with the noneconomic determinants, there is almost no limit to the number of explanatory variables that one can use to explain the level of strike activity. To mention a few, we have degree of unionization (Jones and Walsh, 84), frequency of union convention (Roomkin, 76), percentage of employment in cities over 50,000, Right to Work Law, Permissive Law, Meet and Confer Law, Good Faith Law, etc. (Burton and Krider, 75), and the

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[3]These noneconomic determinants are not necessarily restricted to cross sectional studies. For example, in a time series analysis, Edwards (1978) had a dummy variable to account for the changes in the political climate over time

number of piece workers (Shorey, 76)[4].

Because these cross-section studies tend to have different explanatory variables and different units of observation, and because the number of such studies is still relatively small in the literature, the only general conclusion that can be made from these studies is that both the economic and the non-economic characteristics have an influence on the level of strike activity.

To summarize, this section implies the existence of a systematic association between strikes and certain characteristics of the environment. Thus, any theory of strikes deemed acceptable must at least provide an adequate explanation for this observed association.

The Bargaining Studies.

The primary objective of these studies is to identify the factors that determine the parties' concession rates in a bargaining situation. Among the factors most often cited, there are bargaining powers (Chamberlain, 1951 and 1954), the risk evaluation function (Pen, 1959) and the maximum risk of conflict that the parties are willing to tolerate (Zeuthen, 1930). Strictly speaking, these models are not concerned with strike activity per se. Nevertheless, we can infer from their analyses as to why a strike occurs.

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[4]For a more complete list of the noneconomic determinants, refer to Anderson and Gunderson, 1982.

Central to all bargaining studies is the concept of the zone of potential agreement, defined as the range of possible solutions that the parties can agree upon. In general, the actual solution is indeterminate[5], but this is not an issue that need concern here. What matters is that when a zone of potential agreement exists, it is more advantageous for the parties to agree than to disagree. In other words, a strike will occur only if the zone of potential agreement is nonexistent. To explain this in more detail, let us consider a variant of Chamberlain's cost of agreement and cost of disagreement (CA-CD) model (Cartter and Marshall, 1967).

According to these authors, both the firm and the union are faced with a cost of agreement and a cost of disagreement. The latter is defined as the expected cost of a strike while the former is the loss in profit or in wages for having accepted the opponent's terms. Thus, the cost of agreement to the firm (CAF) increases with the wage demand of the union while the cost of agreement to the union (CAU) decreases with the wage offered by the firm. For simplicity, assume that the costs of disagreement (CDF and CDU) are independent of the wage offers and demands. Graphically, these costs can be represented as follows:

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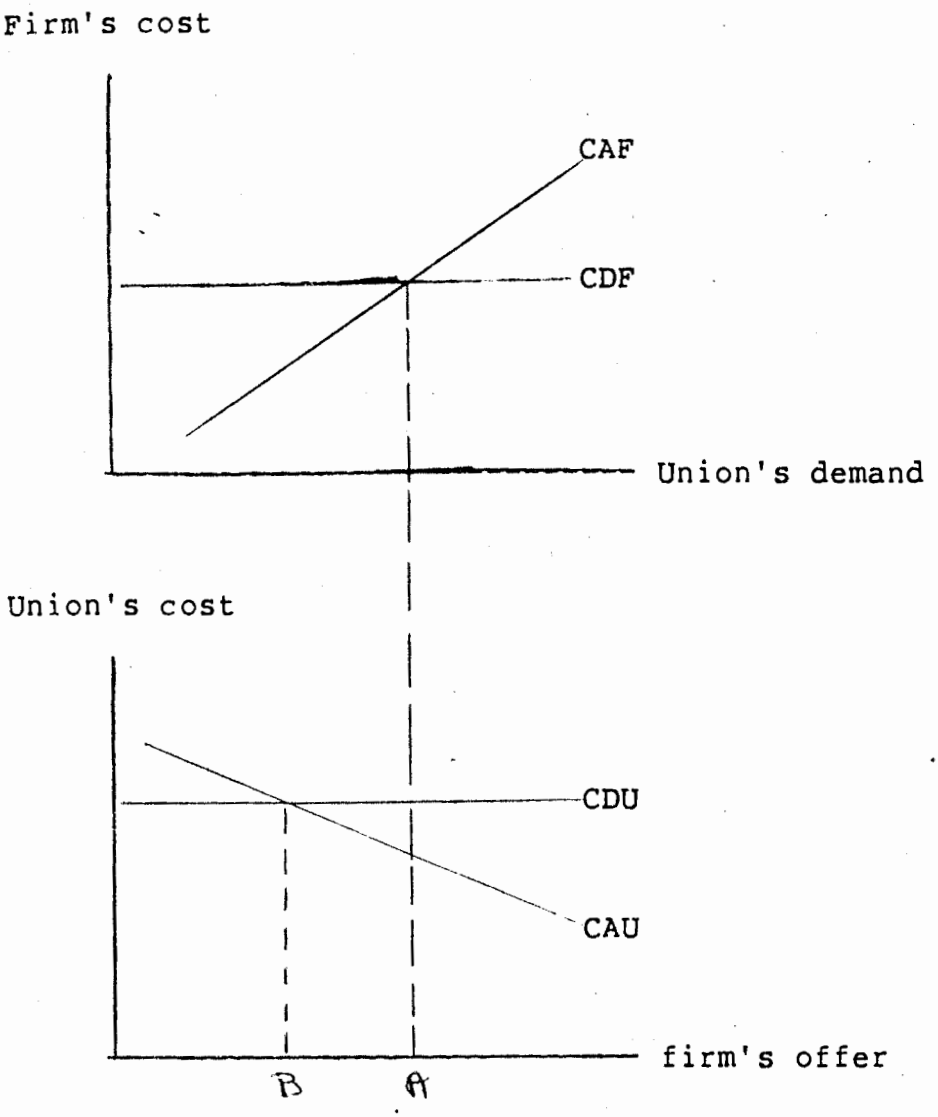
[5]Under certain assumptions, Zeuthen generated a definite solution but these assumptions have been discounted as being unrealistic (Bacharach and Lawler, 1981. Page 6)

Figure I



Wage A represents the maximum wage the employer is willing to pay and wage B is the minimum wage acceptable to the union. Thus, for any wage demand to the left of A, the firm will accept the union's demand since the cost of accepting that demand is less than the cost of rejecting it. Wage demands to the right of A will however be rejected by the firm. By analogy, the union

will accept any wage offer to the right of B and reject any offer to the left of it.

If the critical wage A exceeds the value B (as in Figure I), then a zone of potential agreement is said to exist. It is not known where exactly the parties will settle within that zone, depending on factors such as bargaining skills and experience. For our purpose, it is sufficient to note that the existence of such a zone will preclude the possibility of a strike, since within this zone, both parties will find it more economical to negotiate a settlement than take a strike[6]. Implicitly, this suggests that when the zone of potential agreement exists, the costs of negotiation are less than the strike costs.

On the other hand, if the critical value B exceeds that of A (as in Figure II), the zone of potential agreement is then nonexistent - that is, the maximum wage offered by the firm (wage A) will be unacceptable to the union while the minimum wage (B), acceptable to the union, will be rejected by the firm. Under these circumstances, the negotiation process would not bring about a settlement. In turn, this implies that the parties would find the cost of negotiations prohibitively high and as a result, would opt for the strike mechanism.

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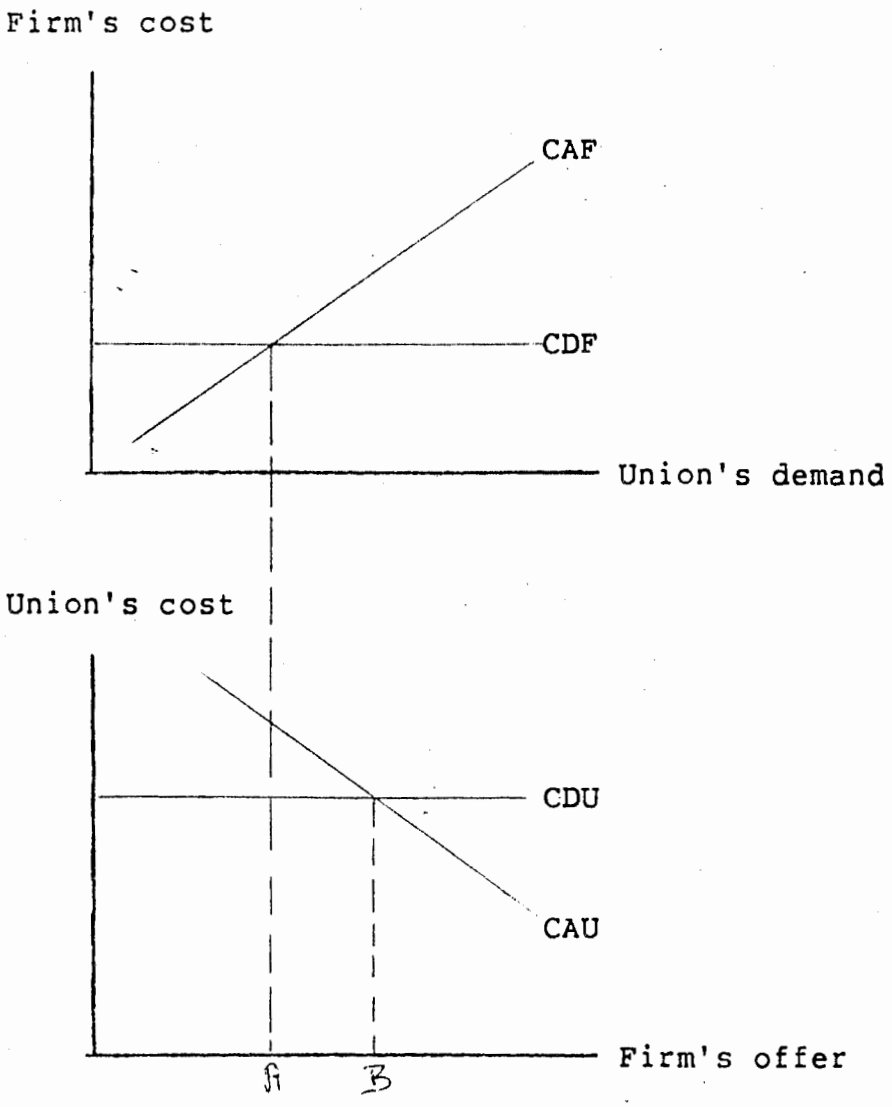
[6]This analysis assumes that the existence of the zone is known to both parties. As we shall see later, there are some models which account for the inadequate knowledge of the parties, and in this case, strikes can occur even in the presence of the zone of potential agreement. These models tend to view strikes as mistakes.

Figure II



Thus, whether a strike will occur depends upon whether the zone of potential agreement exists. Unfortunately, even though the factors that shift the cost curves can be identified, it is not possible to identify the factors that determine the existence of the zone of agreement. While it is plausible to argue that boom times will shift the workers' cost of disagreement curve downward and the firm's cost of disagreement

curve upward, it is not possible to infer from these changes whether the zone of potential agreement exists. The CA-CD model is therefore not amenable to empirical testing and this may explain why the study by Maki and Strand (1984) led them to conclude that the CA-CD model is unable to explain strike incidence. Another problem with this model is that there is no explanation as to how the occurrence of a strike eventually 'forces' the parties into a settlement. That is, it is not clear when a strike will end.

However, in spite of these problems, the CA-CD model contains some very interesting insights. First, it shows that both strikes and negotiations are competing alternatives to conflict settlements. If a zone of potential agreement exists, conflict (that is, disagreement between the parties) will be solved through the negotiation process. On the other hand, if the zone does not exist, conflict will lead to the adoption of the strike mechanism.

Second, the model indicates that the occurrence of a strike is neither an accident nor a mistake. In this analysis, a strike occurs because the zone of potential agreement is nonexistent. That is, both parties find the cost of negotiation too high and that it is cheaper to take a strike than to accept the other side's offer. Thus, the decision to strike is the result of economically rational behavior by the parties.

Third, the model implies that if only one party perceives the net benefit of a strike, then a strike should not occur. For

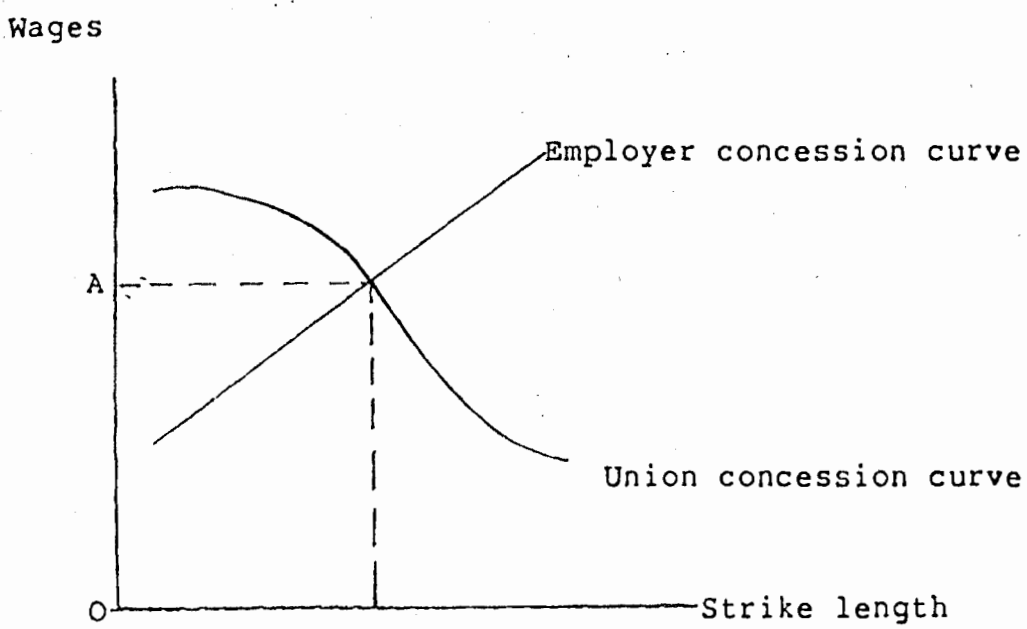
example, consider Figure I. Suppose that the firm has offered wage A and that the union is asking for a wage to the right of A. In this case, only the firm will find it economical to take a strike. Accordingly, we expect the union to concede and accept the wage offered by the firm. Thus, for a strike to occur, both parties must perceive the relative benefits of a strike - that is, a strike will take place only if both parties feel that their respective costs of agreement exceed the costs of disagreement.

The Mistake Studies.

The basic hypothesis in these studies is that strikes are unnecessary mistakes in the sense that if the union and the firm agree to a post-strike wage W, they would have been better off accepting that settlement in the first place without incurring the costs of a strike. This view of strikes is often associated with Hicks (1963) and has been subsequently adopted by Addison & Siebert (1979) and Reder & Neumann (1980).

The model developed by Hicks can be depicted by the following graphical representation:

Figure III



The employer's concession curve is a locus of different combinations of wage rates and expected strike lengths, where for the employer the expected cost of the strike is equal to the expected cost of concession. In other words, for a given expected length of strike, the corresponding wage on the employer's concession curve represents the highest wage the employer is willing to pay rather than take a strike of that duration. The curve is upward sloping because for longer expected strike length, the maximum wage that the employer is willing to pay also increases.

By analogy, the union resistance curve is a schedule representing the minimum wage that the union is ready to accept rather than take a strike of a given duration. The curve is downward sloping since the acceptable wage to the union is

assumed to decline as the expected duration of the strike lengthens.

According to Hicks, the wage rate (OA) at the intersection of the concession curve and the resistance curve represents the highest wage that a skilful union negotiator can extract from the employer. This suggests that a strike occurs because the union demands a wage above the critical wage OA. In Hicks' view, the reason for this high (or 'strike causing') wage demand is because the union negotiator's expectation is based upon incorrect information, leading to a wage demand over and above what the management is prepared to accept.

On the basis of this reasoning, Hicks therefore argues that "the majority of actual strikes are doubtless the result of faulty negotiation." (P. 146), and since "there is a general presumption that it will be possible to get more favourable terms by negotiating than by striking" (P. 144), strikes are therefore mistakes resulting from misinformation.

What Hicks failed to recognise is that information is not a free commodity. To avoid a strike, there is a certain amount of information cost that has to be incurred. It is therefore possible that the more 'favourable settlement' attached with negotiations is not enough to compensate for the information cost involved with avoiding a strike. In this transaction cost framework, a strike is therefore not necessarily a mistake.

In addition, there are other reasons why the 'mistake' view of strikes is unwarranted. First, it is not clear why mistakes

would move procyclically in order to account for the procyclical movement of strike activity. Addison and Siebert (P. 249) argue that at the peak of the cycle, "inflationary surprises or unexpected changes in the unemployment level can be expected to upset established bargaining relationships and increase the possibility of strikes". This argument, however, begs the question of why less such surprises (and the resulting mistakes) exist in a downturn.

Another explanation for the procyclical movement of mistakes (Rees, 1952) is that since unions are backward looking and management forward looking, there is divergence in expectations, and hence mistakes are more likely to occur at the peak of the cycle. While this argument is intuitively appealing, it cannot explain why there is a systematic divergence in expectations and mistakes over time. Since most bargaining relationships are long-term relationships, the parties should eventually become aware of this divergence in expectations at the peak of the cycle, and to the extent that mistakes are costlier to both parties during such times[7], we expect the parties to change the basis upon which their expectations are formed. This adjustment in expectations suggests that over time, the procyclical movement of strikes should eventually dampen

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[7]While it is true that greater outside opportunities are available to both parties during boom periods, there is evidence that the parties do not make use of these opportunities. For example, Gennard (1981) found that part-time work as a source of revenue during a strike was almost non-existent among the striking workers surveyed.

out. In other words, if strikes are indeed mistakes, we should over time observe the movement of strikes to become uncorrelated with the business cycles (that is, with the economic variables). Existing empirical evidence, however, seems to suggest otherwise.

We can therefore conclude that the 'mistake' theory of strikes does not have an adequate explanation for the procyclical movement of strikes. Another problem with this theory is that it cannot explain the existence of strikes as an established institution. Since the strike mechanism is basically a man-made (legal) institution, and since without such an institution, the bargaining parties would be relieved from the possibility of making costly mistakes, we should then expect most bargaining pairs to favor, and to lobby for, the abolition of the strike mechanism. The evidence from the labor market, however, does not seem to support this contention[8]. While some public outcry against strike activity in certain industries does exist, there has never been any real push in Canada toward outlawing strikes by either side of the bargaining table. Thus, if strikes are indeed costly mistakes, the existence of the strike institution must imply that the bargaining parties are economically irrational. This is however unacceptable since the assumption of irrationality violates one of the most fundamental

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[8]In a Conference Board Survey, Kochan (1980) found that avoiding a strike is not considered a major objective by management. This should suggest that abolishing strikes is an even more remote objective of management.

axioms in economics.

To summarize, we disagree with the' mistake' view of strikes on three counts. First, it is based upon the incorrect assumption that information is costless. Second, it has no satisfactory explanation for the procyclical movement of strikes. Third, the 'mistake' view has no rationale for the existence of strikes as an institution.

The Single Party Models.

The basic characteristic of these models is that the strike mechanism is viewed as a device through which one of the bargaining pair can extract higher wages (Rees,1952), additional information (Hayes, 1984) and concessions (Ashenfelter & Johnson, 1970) from the other party. We shall give a brief exposition of these three studies and then show the problems common in all three studies[9].

According to Rees, the workers are more powerful at the peak of the business cycle for two reasons. First, during this period, the union has a better ability to withstand a strike since the striking workers will find it easier to secure temporary employment. Second, the union is in a better position to inflict a higher strike cost on the firm, since any shutdown during peak periods should involve higher output or sales loss.

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[9]For more specific criticisms, refer to Burton and Krider (1979) and Shalev (1980) for their critiques of A and J, and to Vanderkamp (1970) and Walsh (1976) for their comments on Rees.

We should therefore expect the union to 'time' the occurrence of a strike to boom times, so that higher wages can be extracted from the firm. In a sense, Rees therefore considers the strike mechanism as a tactical device that the union uses to obtain higher wages.

In Ashenfelter and Johnson, the basic function of a strike is to lower the expectations of the rank and file and their wage demands. It is implicity assumed that the strike has no effect on management's offer. Whether a strike will occur depends upon the employer's calculation of the strike benefits relative to the strike costs. If a strike is calculated to have a net positive impact on profits (that is, the reduction in wage demand offsets the strike cost), then the employer will reject the union's demand and hence incur a strike. On the other hand, if the strike reduces net profit, then the employer will accept the union's demand. In this analysis, a strike is therefore beneficial only to the employer. The workers have nothing to gain from a strike, since the management's offer is unaffected by the occurrence of a strike.

In the model developed by Hayes, the firm is assumed to have relatively more information (about profitability) than the union. To compensate for its lack of adequate information, the union uses the strike mechanism to ensure that firms in high states (that is, high profits) do not get away with paying low wages. To achieve this end, the union offers a 'final' schedule of wage/strike combinations, where the wage demands and expected

strike lengths are inversely related. Thus, if the firm is in a high state of nature and therefore less inclined to take a strike, it will choose a high wage and no strike (or short strike) combination. On the other hand, if the firm is in a low state of nature, it will choose a low wage and long strike combination.

In Hayes' model, the strike mechanism is beneficial only to the workers, allowing them to (indirectly) extract information from the firm. In a sense, this view of strikes is similar to Rees' but different from A and J's where a strike benefits only the employer.

The problem with these models is that if only one party gains in a strike, this does not explain why the other side should accept a strike. In Rees' model, we would expect the firm with its lower bargaining power to concede rather than take a strike which it cannot win[10]. Both A and J and Hayes rationalize the acceptance of a strike by the 'losing' party in arguing that if the cost of agreeing to the opponent's offer exceeds the strike cost, the 'losing' party will prefer the less costly alternative - that is, the strike. This argument implicitly assumes that rejecting an offer will necessarily lead to a strike. In other words, there is no role for the negotiation process as characterized by offers and counter-offers. At best, A and J and Hayes view negotiations as process where one party

[10]We are here abstracting from the possibility of a mistake by the firm.

makes a 'final' offer, with the other party having no other choice but to accept the offer or to take a strike[11].

While this view of the negotiation process is applicable in cases where the bargaining practice of Boulwarism is adopted, for most bargaining pairs, the negotiation process is however not limited to a 'take it or leave it' situation. As such, the (implicit) assumption made by A and J and Hayes is too restrictive, and we therefore argue that their models cannot adequately explain why the 'losing' party would ever accept a strike. In other words, these models do not have an explanation of why the occurrence of a strike is a decision determined jointly by the firm and the workers.

The Joint Models.

Contrary to the one-party models where a strike benefits one party at the expense of the other, the joint models view the strike mechanism as beneficial (Kaufman, 1981) or costly (Kennan, 1980; Reder and Neumann, 1980) to both parties[12]. A strike can therefore be considered 'integrative' since both

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[11]Thus, even though A and J and Hayes have the same rationale for the occurrence of a strike as Chamberlain, they have different views concerning the negotiation process. In Chamberlain, the negotiation process is an alternative to conflict settlement while in the models developed by A and J and Hayes, it is basically a mechanism through which final offers are rejected or accepted

[12]These benefits and costs are ex-ante - that is, prior to the occurrence of a strike.

parties gain or lose from its occurrence.

In these joint models, the level of strike activity varies with the sum of the parties' strike costs (benefits), denoted as joint strike costs (benefits). Ceteris paribus, the higher the joint strike costs (benefits), the lower (higher) will be the probability that the parties will opt for the strike mechanism.

The implicit assumption in the joint models is that the joint strike costs (benefits) are not separable or that they are distributed such that the bargaining powers of the parties are equal. This assumption is necessary to exclude cases where most of the joint costs accrue to one party, since under these circumstances, the 'weaker' party will always concede, and hence preclude the possibility of a strike regardless of the magnitude of the joint strike costs. As a matter of fact, this assumption is essential for all models explaining strike activity. Otherwise, we do not expect a strike to occur, and in this case, it would not make sense to develop a strike model.

The joint models are relatively recent developments and have not been subject to intensive examination in the literature. We shall therefore provide an in-depth analysis of these models, beginning with Reder and Neumann.

According to these authors, the incidence of strikes is influenced by the institutional arrangements adopted by the negotiating parties. In the present context, the particular institution examined is the 'protocol' which is broadly defined as a set of procedures for negotiating agreements. A

comprehensive protocol covers more states of the world than a simple one, and as a result, it reduces the number of issues at stake between the parties. This in turn is assumed to lower the probability of a strike. A comprehensive protocol, therefore, helps the parties to avoid the strike costs. However, it is also more expensive to specify.

Thus, the type of protocol chosen by the parties involves a balance between the joint strike costs and the costs of developing that particular protocol. Those bargaining pairs with high joint strike costs and/or low specification costs are likely to agree to a more comprehensive protocol. On the other hand, if the parties are faced with low joint strike costs and/or high specification costs, they are likely to agree to a simpler protocol, which in turn should lead to more strike activity. On the basis of this analysis, R and N therefore postulate that strike frequency varies inversely with joint strike costs and positively with specification costs.

To test their hypothesis, R and N assume that the specification cost increases with the number of NLRB elections in bargaining units within an industry, because these elections are usually the result of initial certifications which in turn suggest that protocols for these bargaining units have not yet been designed. The joint strike cost is proxied by relative wages, and intra year variations in inventories and in shipments of finished goods. Ceteris paribus, the higher the intra-year variation in inventories, the lower is the industry's strike

cost because high variability in inventories implies that the production flow is cushioned against shocks from the input sector. On the other hand, given the coefficient of variation of inventories, a high intra-year variation in shipments indicates that timely delivery is a significant concern in the industry, which therefore suggests that for this particular industry, a strike which delays delivery is costly. Finally, the higher the productivity of the workers as reflected by their relative wages, the higher is the strike cost. Thus, R and N expect strike activity to be positively related to the number of elections and the variability of inventories, and negatively related to relative wages and the variability of shipments.

A major problem with R and N is their postulated relationship between the comprehensiveness of a protocol and the cost of designing such a protocol. It is argued that a complex protocol which by definition reduces the level of strike activity, is costly to design. This is however not necessarily the case. For example, consider a protocol which sets the terms of a contract to follow those agreed upon by other bargaining pairs. This protocol can be considered comprehensive since it reduces the extent of disagreement between the parties. Yet such a protocol should not be expensive to design. Thus, contrary to R and N, there is no necessary relationship between the comprehensiveness of a protocol and the cost of designing that protocol.

It also appears that in their model the cost of a unit of strike activity is not very well defined, since it could be interpreted either as the cost per strike day or as the total strike cost, defined as the cost per strike day multiplied by the strike duration. If one assumes that the cost of a unit of strike activity is taken to mean total strike cost, then R and N's postulate indicates that when the total strike cost is high, the strike duration will be short. Mathematically, this is inconsistent because for a given strike cost per day, a high total strike cost must necessarily imply a strike of long duration.

Hence, by cost per unit of strike activity, we suspect that R and N mean strike cost per day. Thus, according to these authors, when the strike cost per day is high, the parties are more likely to develop a complex protocol. However, this needs not be the case because for most bargaining pairs, their primary concern is to avoid the total strike cost, and as we shall see below, there may be no positive relationship between the strike cost per day and the total strike cost. In other words, even though the parties want to avoid a high total strike cost, they may not develop a complex protocol to avoid a high strike cost per day because the latter may in fact be associated with a low total cost.

Let us now examine the validity of the postulated inverse relationship between the strike cost per unit of time and the strike activity. If one argues that during boom times the joint

cost of a unit of strike activity is high because of high output or sales loss, then R and N's model predicts a countercyclical movement in the level of strike activity. This is contrary to the evidence that strikes move procyclically. Further, if we make the reasonable assumption that a high strike cost per unit of time increases the concession rates of the parties, then when the cost is high, we expect the strike mechanism to be more viable as a means to settlement. This in turn implies a positive relationship between strike cost and strike frequency.

With regard to the empirical section, R and N argue that high variability in inventories implies low strike costs. As we shall see later, R and N's postulated inverse relationship between variability in inventories and strike costs is an empirical issue, depending upon the sign of the correlation between inventories and shipments. On the basis of our estimated correlation coefficient between these two variables, the evidence suggests that, contrary to R and N's postulate, the variability in inventories and strike costs are positively related.

It has also been pointed out by Maki (1984) that R and N's postulated relationship between inventory variability and strike cost might not hold if the picket line prevents any transaction between the industry and its customers. In addition, Maki argues that the magnitude of the safety stocks should be added to the variability in shipments as proxies for the premium placed on the timeliness of delivery.

Another problem with R and N's empirical analysis is that the dependent variable is not properly measured. Instead of using strike frequency per se, R and N should have adjusted the frequency measure to account for the number of contracts expired, because one would expect more strikes if there are more contracts being negotiated. In other words, to explain strike frequency, the number of contracts up for renewal must be taken into account.

Let us now consider the model developed by Kaufman. The basic idea in this model is that the negotiation process is costly. First, there are direct costs such as the salaries of the negotiators and overtime payments due to increased production in anticipation of a strike. Second, there are indirect costs which are incurred in the sense that the longer it takes to reach a settlement, the smaller will be the present value attached to that agreement.

Thus, if negotiations are expected to be lengthy, then the parties will have an incentive to seek an alternative mechanism through which a settlement can be reached in a shorter period of time. Kaufman argues that the strike mechanism is one such alternative, since it is hypothesized to speed up the concession process by increasing the cost of disagreement. In this context, a strike is therefore beneficial to both parties, helping them to minimize the direct and indirect costs involved with the negotiation process. It is expected that the preference for the strike mechanism varies positively with the length of

negotiation.

For empirical purposes, Kaufman assumes that the length of negotiation varies positively with the initial difference between wage demand and wage offer, and negatively with the speed of concession. Given the positive relationship between strike frequency and negotiation length, a large demand-offer differential will therefore increase strike activity while rapid concession during negotiations will decrease the need for the strike mechanism.

The magnitude of the initial wage difference is posited to vary positively with the divergence in price expectations by the parties concerned, and with past rates of inflation. On the other hand, the existence of an escalator clause in the contract, the unemployment rate, and the profit rate are assumed to have a negative impact on the wage difference.

With regard to the speed of concession, it is argued that this is influenced by the amount of information available and by the cost of bargaining. However, in so far as the empirical testing is concerned, the speed of concession is not considered at all. Instead, the focus is entirely on the magnitude of the wage difference.

The model developed by Kaufman differs from the R and N model in one important aspect. In the latter, a strike has no function other than imposing a deadweight loss to the parties. In contrast, Kaufman shows that a strike is a useful device in reducing the costs of lengthy negotiations. Accordingly, Kaufman

can easily rationalize why the bargaining parties have so far accepted the existence of the strike mechanism as an institution. It is in this sense that Kaufman's model is a major improvement over the one developed by R and N.

However, what Kaufman overlooked in his analysis is that the preference for a strike depends not only on the length of negotiation but also on the expected length of the strike. In other words, it is possible that even though negotiation is effective in getting a settlement, the parties can still prefer the strike mechanism if the latter is relatively more effective than the negotiation process in inducing a settlement. To be correct, Kaufman should have shown that strike frequency increases with negotiation length and decreases with strike length.

In addition, one can argue that the empirical portion of Kaufman's study is incomplete because even though it was postulated that the frequency of strikes depends on the initial difference between wage demand and wage offer and on the speed of concession, the estimating equation completely neglected the last factor.

To recapitulate, the joint models view the strike mechanism as integrative in nature - that is, in these models, a strike does not benefit one party at the expense of the other. Rather both parties gain or lose because of a strike, and the major contribution of these models is that they help explain why a strike is a joint decision, while at the same time producing

empirically testable hypotheses[13].

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[13]As we have explained earlier, the bargaining studies do show why a strike is a joint process but their analyses are not testable.

III. Highlights of the Survey

This section integrates the insights gained from the previous section into a number of questions that a theory of strikes should answer. First, to be consistent with the empirical evidence, a strike theory should explain why the economic environment of the unit of observation has a systematic influence on strike activity[1]. Of the four classes of strike theories that we have discussed, the bargaining and the mistake studies do not appear to have a satisfactory answer for this question.

In the bargaining studies, a strike occurs because of the nonexistence of the zone of potential agreement. The problem is that the factors which determine the existence of such a zone are not identifiable. As a result, the bargaining studies cannot explain why the economic environment has a systematic influence on strikes. On the other hand, while the mistake studies do provide a satisfactory answer for why mistakes and hence strikes are associated with variables depicting boom times, they cannot explain why this association should persist over time. Given that the parties would adjust their expectations to avoid costly strikes, we would expect that over time the relationship between divergence in expectations and boom times would disappear.

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[1]Thus, if the theory purports to explain strike activity over time, its analysis should also provide a rationale as to why strike activity varies directly with the business cycle.

Regarding the other studies, this question should pose no problem because they can easily rationalize why one or both parties systematically gain from a strike during boom times[2]. Thus, these models are able to explain why strikes are influenced by the economic environment.

The second question that a strike theory should answer is why the occurrence of a strike is a joint decision - that is, why both parties take a strike rather than agree to their opponent's position. With the exception of the one party models, the studies surveyed do satisfactorily answer this question. In the bargaining studies, the parties choose to strike when they find that there is no possibility of a settlement through the negotiation process. In the mistake studies, the answer is self-evident and perhaps trivial. The party that should not accept a strike, makes a mistake and hence 'agrees' to strike. In the joint models, a strike is 'integrative' in the sense that both parties gain or lose from its occurrence. Implicitly, this suggests that the occurrence of a strike is a joint decision.

In the one-party models, a strike is 'distributive', with a 'winner' and a 'loser' from its occurrence. The problem with these models is that they cannot rationalize why the loser should ever accept a strike, unless they make the unrealistic assumption that Boulwarism is a common practice among bargaining

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[2] For example, in A and J, the workers are assumed to be more demanding during boom times. As such, the firm will find it more profitable to reject the wage demand and hence incur a strike.

pairs[3]. Another possible assumption is to assume the ignorance of the loser. This however simply changes the one party model into a mistake model.

Finally, the third question is, given that the negotiation process and the strike mechanism are competing alternatives to conflict settlement, then why should both parties choose the strike mechanism over the negotiation process. On the basis of the studies surveyed, only the bargaining studies have alluded to this issue. It is argued that when the zone of potential agreement is nonexistent (Chamberlain's Model) or when the negotiation process is lengthy (Kaufman's model), the cost of negotiations will be high, and as a result, the parties will prefer the strike mechanism. This is however an incomplete analysis. To be complete, the preference for a strike depends not only on the costs of negotiations but also on the strike costs.

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[3]See pages 21-22.

IV. The Theoretical Model.

The proposed model presents an alternative version of strike activity, and in this version, all three questions posed in the previous section are accounted for. Further, since a strike is not expected to occur in the absence of conflict (or disagreement) between the parties, a prerequisite to any explanation of strikes therefore involves an explanation of why conflict exists in the first place. Accordingly, the first half of the proposed model examines the existence of conflict and its effect on the labor market. In this analysis, conflict is inherent in the employer-employee relationship because of the absence of property rights on the 'pie', defined as the extra output resulting from the benefits of team production. This inherent conflict is costly to both parties and as a result, a number of institutional arrangements have been developed to minimize the extent of conflict and its related costs. These institutions include contracts, grievance arbitration, pattern following, compulsory arbitration, negotiations, and strikes.

In the second half of this model, the focus is on the question of why a strike occurs. This model presumes that the occurrence of a strike is functional in the sense that the strike mechanism, among other things, helps the parties reach a settlement by increasing the cost of disagreement. Now, given that other means of settlement also exist, a strike will therefore occur when both parties perceive that the total cost

of reaching a settlement under the strike mechanism is less than that of the other options, in particular the negotiation process. This is hypothesized to depend on the size of the 'pie' to be shared by the parties, the existence of post-contractual opportunism and the magnitude of the joint strike cost per unit of time[1].

Conflict and The Labor Market Institutions.

The starting point for this analysis is the concept of team production. By definition, team production refers to a situation where the contribution of each member to the team output is difficult or impossible to identify. The workers will form a team to produce a particular commodity if the total output produced by them working separately is less than the output that could be produced if these same persons had formed a team, with each member specialising in producing only part of the product[2]. In other words, where team production enhances output, it would

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[1]Using the terminology developed by Reder and Neumann (1980), joint strike cost is here defined as the sum of the parties' strike costs combined. To avoid the problems associated with this definition, it is assumed that these costs are distributed such that the parties' relative bargaining powers are unaffected.

[2]An interesting application of this view is that layoffs are costly not only to the laid-off workers but also to the workers still employed. More often than not, the latter have to take over the tasks previously performed by the laid-off workers, and as a consequence, some reduction in the benefits of specialisation are experienced by all the existing members in the team unit.

beneficial for the workers to form a team. However, in spite of its positive returns, team production is restrained by the threat of cheating (or shirking).

The problem of shirking in team production is set forth in Alchian and Demsetz (1972). According to these authors, the marginal contribution of each individual to team output is usually unidentifiable, thereby making the control of opportunistic shirking difficult. As a result, there are incentives for some members of the team to shirk from their responsibilities, and the consequence of their action is postulated to have a Gresham effect on the other workers. That is, the honest workers are not fully compensated for their efforts so that they will also start cheating. This may lead to the dissolution of the team unit.

Thus, to guarantee the existence of team production, there must be some form of policing to prevent shirking by the team members. One possible arrangement is for the workers to monitor each other. The problem that may arise with this arrangement is that instead of monitoring opportunistic behavior, the workers may end up monitoring the efforts of their colleagues in the opposite direction - that is, they may prevent the other workers from working too hard so that their own deficiencies are not exposed.

Another arrangement is for the workers to hire a monitor to examine the final product, to evaluate the contribution of each worker and to pay them accordingly. This arrangement may work,

but where production is inseparable, the use of an outside monitor would be too costly.

Another alternative is for the workers to 'merge' with a party who would be responsible for monitoring and for directing the activities of the workers right from the start of any productive activity. What we have here is an employer-employee relationship and in this context, the employer or the firm is essentially a monitor[3].

In this model, the relationship between the firm and the workers can be viewed as a convenient arrangement to allow team production to survive, and to allow the workers to enjoy the benefits of specialization. Let us call this additional output resulting from the benefits of team production as the 'pie'.

This pie can be regarded as an asset resulting from the interaction between the firm and the workers. In effect, both parties have valid reasons to claim the pie as theirs. To the workers, the pie is the result of their productive efforts. On the other hand, the firm can argue that the pie would not exist if it was not for its monitoring activities. Because of the difficulty or impossibility in measuring each party's contribution to the pie, the property rights to this pie is

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[3] To facilitate its activities, the monitor usually provides the place where all the team members can work together, because otherwise monitoring would be more difficult. Furthermore, it is easier to control the amount of inputs used if the monitor supplies them instead of having each worker use their own and then report to the monitor the amount used. The monitor is therefore the source for all the capital needed in production because this allows him to have better control.

therefore not well-defined[4]. In general, the firm is said to have the right to the residual earnings and what this amounts to is that the firm's share of the pie will be larger if it is able to pay the workers a smaller share[5]. Assuming that both parties prefer a larger share of the pie to a smaller share, this lack of well-defined right to the pie is therefore bound to create conflict, defined as the disagreement between the employer and the employees over the sharing of the pie.

Now, to the extent that the employer and the employees will get together only if the pie is positive, it must then be the case that conflict is inherent in the relationship between the parties[6]. Having gone through the rationale for the existence of conflict, I shall now provide a framework for integrating the various institutional responses to conflict. But first, let us examine why such responses are necessary.

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[4]If the measurement problem was nonexistent, the law could have partitioned the pie right down to each party's actual contribution - for example, 46% going to the firm and 54% to the workers.

[5]There is of course a lower limit that the firm will be willing to pay the workers. This should be equal to the costs of hiring and training new workers. To the extent that these costs differ among firms because of specificity in investments and production techniques, competition in the labor market therefore does not guarantee that the workers' share of the pie in a particular firm will be well-defined.

[6]This view of conflict is similar to the pluralist approach to conflict, where its proponents also tend to view conflict as inevitable. For more details on the different approaches to conflict, refer to D. Nightingale (1974).

In the absence of any contractual and/or institutional arrangements, the parties will continuously disagree on how to share the pie. At the start of each working day, the parties will have to negotiate the share structure and determine the value of the pie. This need for continuous negotiation not only leaves the parties less time for the enhancement of the pie, but will also give rise to behavioral responses which will reduce the size of the pie[7]. The firm, for example, will have incentive to subcontract out some of its projects and to employ a higher capital-labor ratio than optimum. Similarly, the workers will be more inclined to shirk from their responsibilities or to use the final product for personal benefits. In the limit, this competition for the pie may lead to "dysfunctional" conflict symptoms such as quits, sabotage, mass firing, and so on (Barbash,1977).

On the basis of the above, it can therefore be argued that unrestricted conflict will lead to a reduction in the size of the pie. Assuming that this dissipation is viewed as a waste by both parties and that the cost of changing partners is high, it is therefore beneficial for the parties to develop a set of institutional arrangements to limit and to regulate the inherent

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[7]The concept that resources will dissipate because of nonexclusive rights is attributable to Cheung's paper on the theory of rent control (1974). This concept is similar to the common property problem, where because of the inability to secure the ownership of a piece of land, there will be a tendency towards over-using or over-grazing that land, thereby leading to a decrease in its value.

conflict between them.

The most important of these arrangements is the contractual arrangement, which defines the rights of the parties, the way the pie is to be divided, the payment system, and so on[8]. Agreement over these issues is usually reached on the basis of predictions about future states of the world and of any error of prediction made in the past.

In this paper, a contract can be viewed as an arrangement where the parties agree to assume that certain states of the world will occur over a period of time and to behave as if these assumed states are facts even though they might not actually concur with real world events. Thus, over an agreed period of time, the parties will behave as if the actual value of the pie and/or the actual contribution of the parties are known when in fact, they are not. In this view, the basic function of a contract is to get the parties not to disagree over the sharing of the pie for a certain period ot time regardless of whether world events proceed as expected.

The contractual arrangements agreed to by the parties vary in form and content, but in general, they can be classified either as a fixed wage contract or a flexible wage contract. In the latter case, the parties only agree on the relative share structure of the pie and let the absolute amount that they will

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[8]This contractual arrangement is usually determined collectively in a union environment and singlehandedly by the firm in a nonunion environment.

receive vary with the future value of the pie. In other words, the wage received by the workers fluctuates over time and is contingent upon the value of their output. Examples of such arrangements include stock brokers working for a commission and garment workers on a piece work payment.

In the fixed wage contract, the arrangement is for the employer to buy the workers' share of the pie for an agreed lump-sum amount, payable at regular interval over a number of years. Under this contractual arrangement, the payment received by the workers is fixed over time (for example, hourly wage rate). This is by far the most common contractual arrangement, and there exist a large number of studies in the contract literature geared towards explaining this stylized fact. The explanations range from the risk aversion of the workers (Gordon, 1974; Azariadis, 1975) to the minimization of transaction costs (Mayers and Thaler, 1979). It has also been suggested that the choice of the fixed wage contract involves a balance between the cost of monitoring the workers' effort and the cost of detecting opportunistic behavior by the firm (Chant, 1981).

There is no doubt that the issue of fixed wage contracts versus flexible wage contracts is important, but to pursue this subject any further is beyond the scope of this paper. For our purposes, it is more relevant to focus on two of the less discussed features of contracts and the institutional arrangements arising from these features.

First, because of the costs involved in specifying all possible contingencies in a contract, the parties usually agree to a 'loose' contract, defined as a contract where the contractual agreement tends to be 'silent' on certain issues or where the contract language is purposely left ambiguous on these issues. A contract is therefore often open to subjective interpretation and this tends to encourage post contractual opportunistic behavior. Klein, Crawford and Alchian (1978) appear to be responsible for this concept, and it can be defined as the incentive to cheat during the life of the contract. In its extreme form, post contractual opportunism involves the outright repudiation of the terms of agreement.

These behavioral responses in effect undermine the basis for developing a contract. To minimize the impact of these actions, the parties have developed an institutional arrangement where in the event of a dispute arising over the terms of the contract, they will refer their disagreement to a third party, whose decision is binding. This arrangement is commonly known as grievance arbitration[9]. In this view, the grievance mechanism serves two purposes. It ensures the smooth running of the contract and it relieves the parties from having to specify a 'tight' contract.

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[9]Another possibility is for the parties to settle their disputes in court. This alternative would however entail higher time and money costs than the grievance mechanism. Further, because of the 'loose' nature of contracts, post contractual opportunism may not be necessarily illegal and accordingly, legal redress may not be available to the aggrieved party.

The second feature that I want to discuss is the temporary nature of the contractual arrangements. Since long-range predictions are likely to be less accurate than short-range forecasts, contracts are signed for only short periods of time, usually between one to three years. This therefore indicates that the relationship between the firm and the workers over time can be characterized as a series of contracts interrupted by periods during which the parties search for a new contract.

During this no-contract period, the parties have to search for the future money value of the pie and for a share structure that is not only acceptable but also perceived to be the best by both sides[10]. Thus, throughout the duration of the no-contract period, both parties will attempt to convince the other side to agree on its own terms, and it is assumed that the success of these attempts is contingent upon the amount of accurate information that the parties have on their opponent[11]. This includes information on their fall-back position, concession rates, and ability to take a strike.

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[10]For the purpose of this paper, I shall not analyze in any detail how the parties' perception of the 'best' contract is formed. Presumably, this depends upon factors such as bargaining power.

[11] Quite often, information is released by the opponent to deliberately mislead the searcher. As such, the bargaining parties have to sort out which of the information acquired is accurate, since only accurate information is of significance to them.

The search for a new contract therefore involves a search for information on the future values of the pie and on the bargaining position of the opponent. The position adopted in this paper is that the search for this information is costly, involving time and money.

The searchers have to be paid for representing the parties, and perhaps more important are the opportunities lost due to the time spent searching. For example, because of search, the employer has less time for policing. This should increase opportunistic shirking, and hence cause a fall in production and/or the quality of the product[12]. To minimize this 'time cost', the monitor often employs labor-relations specialists to do the search. However, in the study by Godard and Kochan (1982), it was found that in the majority of the firms surveyed, the labor-relations specialists are confined to 'boundary-spanning' roles, thereby suggesting that the more important decisions in search still fall under the responsibility of the monitor. In addition, the longer is the search time, the more likely customers will be to switch to rival firms for fear of having their supplies cut off[13]. Finally, depending on the search mechanism adopted, the search

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[12] Imberman (1979) found that productivity usually declines about 2% to 12% in the 3 or 4 weeks preceding the strike.

[13] For example, in July 1978, Inland Steel reported 100,000 tons of lost orders because of strike threats (Imberman, 1979. p. 134).

for a contract may entail a complete interruption of income to both parties.

Thus, where the cost of acquiring information is high, there will be a tendency for the parties to acquire less information and agree to a 'suboptimal' contract, defined as a contract where the agreed share structure and the money value of the pie are less likely to reflect their actual future values. To facilitate this tradeoff between information acquisition and suboptimal contracts, a number of institutional arrangements have been developed. They include pattern following, arbitration, and the strike/negotiation route[14].

These institutional arrangements serve as a tie between contracts, and their basic function is to produce a contractual arrangement for the parties. They however differ in terms of the way in which the information necessary for a settlement is gathered, and in terms of the optimality of the contract. The choice of any of these institutions therefore depends upon the benefits from economizing on information costs weighted against the costs of a suboptimal contract. The latter include the costs of having dissatisfied parties working together and/or the costs

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[14]To limit our analysis, we shall not deal with nonstoppage strikes, defined as strikes where the parties continue on with the business operation and for example donate an agreed amount to their favorite charity for each day they are on 'strike'. To the best of my knowledge, this form of 'strike' is not practiced in Canada. This may be due to the fact that nonstoppage strikes do not necessarily speed up the concession process since the monetary loss resulting from the donation may be largely offset by the nonpecuniary benefit of that donation, so that the full cost of such a strike is negligible.

of having a settlement which reduces the competitiveness of the firm.

To begin with, let us consider arbitration which can be viewed as an institutional arrangement where the bargaining parties delegate the responsibility of searching for a contract to a third party whose decision is binding[15]. This arrangement saves the parties from having to acquire information from each other, and should the arbitrator be efficient in search, arbitration would be a viable institution through which a contract can be agreed upon. However, the bargaining parties have been generally reluctant to opt for the arbitration institution for a number of reasons.

First, while compulsory arbitration allows the parties to save on the costs of acquiring information, they still have to spend resources in finding an 'appropriate' arbitrator. It is possible that it may take the parties longer to agree on who the third party should be than to reach a contract settlement on their own. Further, the parties have to pay for the services of the arbitrator. These costs in effect reduce the savings in information costs.

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[15]It is this power to make binding decision that distinguishes the arbitrator from the conciliator, the mediator and the fact-finder. While these individuals also intervene in the search process, they are however not responsible for producing a contract settlement. Instead, their function is to help the bargaining parties who have decided to search for a contract on their own, by reducing the interpersonal problems between the parties and by providing additional information that the parties might have overlooked. (Anderson and Gunderson,1982)

Second, arbitration tends to have a 'narcotic' effect on future search. That is, third party intervention creates the free rider problem, with both the union and the employer relying on the third party to do the search for them in the future. To the extent that a third party does not have the necessary 'inside or first-hand' information to produce an optimal contract, the narcotic effect of arbitration will carry this problem into future contract settlements.

Another problem is the 'chilling' effect of arbitration. Because of the tendency for the arbitrator to split the difference between the proposals of the parties, the behavior of the arbitrator tends to encourage the parties to be less concessionary and to submit extreme proposals. This chilling effect in turn implies that the contract decided by the arbitrator will be far from what either party wanted, especially if the parties failed to anticipate the offer of their opponent. Thus, a contract generated from arbitration has a high probability of having at least one party dissatisfied with it.

Finally, because the decision of the arbitrator is binding, the bargaining parties run the risk of having to live with a contract which they are completely opposed to. In this sense, compulsory arbitration is often perceived as the riskiest option among the institutional arrangements, and as such, it is not a popular form of contract search.

To recapitulate, the bargaining parties have been generally unwilling to rely on a third party to produce a contract

settlement, since arbitration is usually perceived to have a minimal effect in reducing the cost involved in the search for a contract. Furthermore, the probability that both parties would be dissatisfied with the contract awarded by the arbitrator is expected to be high. It is therefore not surprising that the arbitration route is seldom used, except in services designated as 'essential'. The bargaining pairs in these industries are compelled by law to opt for the arbitration procedure.

The next institution that I shall discuss is the pattern following arrangement, defined as an arrangement where the parties adopt a weighted average of the terms agreed upon by other bargaining pairs. In effect, this arrangement reduces the search cost for a contract to almost nothing. The parties do not have to acquire information about each other, nor do they have to know about the future value of the pie. Set against this zero search cost is the high cost involved with a suboptimal contract. That is, should the economic conditions particular to a firm become unfavourable relative to the industry's conditions, the firm in question will be worse off if it has agreed to a contract based upon pattern following[16].

On the basis of the above, we would therefore expect the pattern following arrangement mainly in firms which have a high degree of flexibility in adapting to unforseen shocks. This

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[16] This argument implicitly assumes that firms are not identical. Otherwise, the economic conditions faced by a particular firm should be the same as the industry's conditions.

would include firms which have a large pool of part-time workers and firms which are in a union-free environment. Further, for the nonunionized firms, there is an added incentive to adopt the pattern following arrangement, since it provides these firms the convenience of not having to search for a contract with each and every member of their organizations.

The last institution that I shall examine is the negotiation/strike route. Once the parties have chosen this arrangement as a means to settlement, the law requires the parties to commence bargaining after a written notice has been served by either side, and that bargaining is to be carried out in 'good faith'[17]. What this implies is that the negotiation/strike institution indirectly provides the parties with a set of rules under which they have to agree on the time and place of meetings, to bargain with the representatives of their opponent, and so on. In this view, the negotiation/strike institution provides the parties with an opportunity to communicate and to exchange information regarding their bargaining positions. This route will therefore be used by those bargaining pairs who rely upon themselves to search for a contract, and as we shall see below, these bargaining pairs operate in a union environment.

Assuming that the bargaining parties have first-hand information on the environment in which they operate, they are

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[17]See British Columbia Labour Code, sections 61 to 63.

therefore in a better position to produce an optimal contract. Now, given that the cost of a suboptimal contract is quite high in a unionized setting because of the lack of flexibility in implementing changes[18], one would expect unionized bargaining pairs to rely upon themselves to search for a contract. In turn, this implies that they are more inclined to adopt the negotiation/strike institution.

Further, since it is not expected that the firm will negotiate with each and every member in the organization, and to the extent that the union acts as a 'voice' for the workers[19], we would expect the parties who rely upon themselves to search for a contract to be unionized bargaining pairs.

Having explained why the bargaining pairs in a union environment are more likely to adopt the negotiation/strike institution, let us examine the conditions under which the parties will choose the strike mechanism over the negotiation process, defined as bargaining with workstoppage and bargaining without workstoppage respectively.

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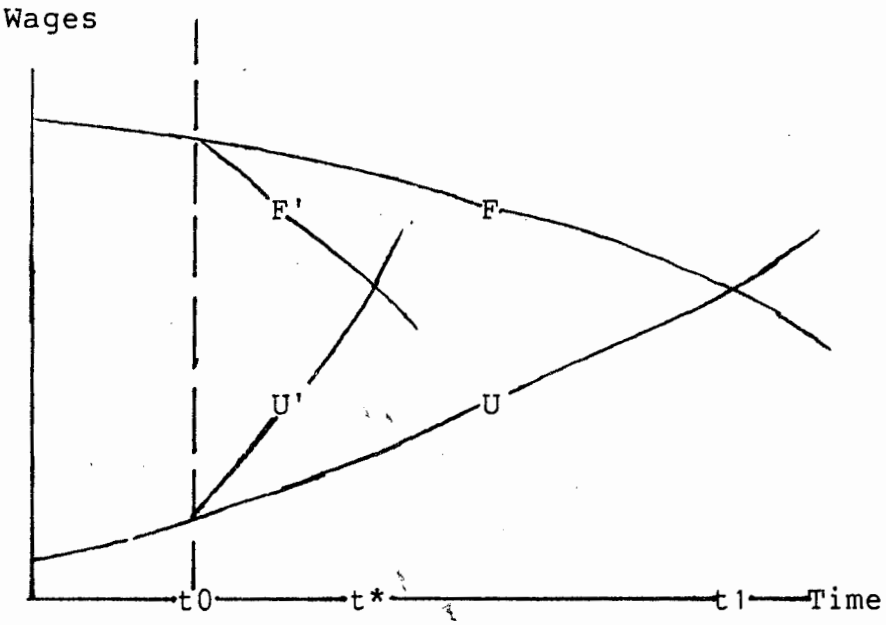
[18] In general, a contractual agreement can be viewed as an arrangement where the parties agree to refrain from certain actions. Thus, the lack of flexibility in implementing changes comes from what is in the contract. Assuming that unionized workers have more 'power' than nonunion workers, a firm in a union environment is therefore more likely to sign a contract which puts restrictions on management's rights.

[19] See Freeman and Medoff, 1981.

Why Does A Strike Occur?

On the basis of what has been said above, both the strike mechanism and the negotiation process serve the purpose of helping unionized bargaining pairs search for a contract. To illustrate the difference between the strike option and the (pure) negotiation option, consider the following figure which is a modified version of the one developed by Kaufman (1981). The F curve represents the firm's concessions over time while the U curve is the union concessions curve. These concessions are made in the absence of workstoppages and the parties would reach a settlement at time t1. However, if a workstoppage is to occur at time t0, the firm's concessions curve would shift to F' and to U' for the union. These shifts represent increases in concessions and under these circumstances, the parties will settle at time t*.

FIGURE IV



In this framework, the distinguishing feature of the strike mechanism is that it speeds up the bargaining process by increasing the cost of disagreement per unit of time, and the bargaining parties will opt for the strike mechanism if the total cost of reaching a settlement under this option (hereafter denoted as total strike cost) is lower than that of the negotiation process (denoted as total negotiations cost). This depends upon the magnitude of the 'pie' paid to the workers and upon the search costs involved with the strike mechanism and the negotiation process[20].

Before we discuss the nature of the relationship between the above variables and strike incidence, it is helpful to digress and examine the bargaining process that is implicitly operating in the background[21]

At any point in time during the bargaining process, the parties are faced with three possibilities: acceptance of the offer, rejection of the offer with further negotiations, and rejection of the offer with workstoppage. If one party accepts the opponent's offer, a settlement is reached and this is the end of the story. But if the party rejects the offer and if that offer is final, then a strike will ensure. Otherwise, further

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[20]For a more detailed description of these costs, refer to pages 44-45. For our purposes, it is also important to distinguish between total cost and cost per day. The former is defined as cost per day times the duration of search.

[21]The proposed characterization of the bargaining process is highly simplified but this will suffice for our purposes.

(pure) negotiations and counteroffers will follow. Thus, the occurrence of a strike depends upon the status of the rejected offer, and among other things, the latter will depend upon the expected search costs under the negotiation and the strike options[22].

Throughout this model, it is implicitly assumed that information is imperfect. Otherwise, a contract would be signed without having the parties go through the bargaining process. Assuming the existence of misinformation, our analysis will focus entirely on the cost differential between strikes and negotiations. In this context, the occurrence of a strike is the result of rational, cost-minimizing behavior by the bargaining parties. Thus, contrary to the Hicksian model, a strike in the presence of information deficiencies is not a mistake.

At this stage, let us go through a more rigorous version of the proposed model. It is assumed that both parties know the magnitude of the pie that the workers will receive, should the firm 'lose' the strike. This share, denoted as W, may be equal to the union's pre-strike demand or less. In a sense, W can be regarded as the stake of the strike. Also, assume that if the

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[22]The estimation of these costs can change over time. We shall however not attempt to explain why and how these estimates are revised. For our purpose, it is only sufficient to note that these revisions will lead to changes in final offers over time. In turn, this explains why bargaining parties might switch between options. To complicate the model, one can also introduce the influence of counter offers on final offers. This is however beyond the scope and intention of this paper.

firm 'wins' the strike, the workers receive nothing[23]. Further, let us define Pf as the firm's and Pw as the union's estimates of the probability that the union will 'win' the strike. We assume that both Pf and Pw are functions of the strike outcome, W, and that their first derivatives with respect to W are negative. That is, if a strike loss is costly to the firm, both parties will reduce their estimates that the firm will lose that particular strike.

Let us now examine the firm's total strike and total negotiation costs, and analyse how the firm makes its lock-out decisions.

The Firm

If the firm wins the strike, the only cost that it would incur is the total amount of resources that have been spent in searching for a contract under the strike mechanism. We denote this search cost as Cf[24] and for the moment, it is assumed to be given. We shall relax this assumption later. On the other hand, if the firm loses the strike, its total strike costs would be augmented by the amount of the pie that the firm has to pay to

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[23]This assumption is made for mathematical convenience. We could have instead assumed that the workers receive a share of the pie equivalent to W1, but this would not change the basic conclusions of our model.

[24]It is helpful to think of Cf as the firm's total cost of reaching a settlement under the strike option.

the workers. Thus, the expected total strike costs of the firm (TS) if a strike occurs can be denoted as :

(eq.1) $$TS = Pf(W + Cf) + (1 - Pf)Cf$$
$$= Pf.W + Cf$$

Should the negotiation process produce a contract settlement, the firms's total costs under this mechanism (TN) would be the amount it has spent in searching (Nf)[25] plus the magnitude of the pie obtained by the union through the negotiation process (Wu). Mathematically, the total negotiation cost is given as:

(eq.2) $$TN = Wu + Nf$$

Let us now define W* as the maximum pie that the firm is willing to offer the workers in order to avoid a strike. In other words, the maximum total negotiation cost that the firm is willing to incur is:

(eq.3) $$TN^* = W^* + Nf$$

For any demand above W*, the firm will be willing to take a strike or to lock-out the workers. Another way of saying this is

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[25]Nf is defined in a similar fashion as Cf.

that if the workers reject W*, the firm will find it more economical to opt for the strike mechanism. We assume that the probability that the workers will reject the firm's 'final' offer is inversely related to the magnitude of W*. Thus, the higher is W*, the lower is the probability of rejection and hence, the lower is the firm's estimate of the probability of a strike occurrence, S. Mathematically, this suggests that the first derivative of S with respect to W* is negative[26].

The firm's maximum expected cost of the contractual agreement can thus be expressed as:

$$\text{(eq.4)} \qquad \begin{aligned} TC &= S \,.\, TS + (1 - S) \,.\, TN^* \\ &= S(Pf.W + Cf) + (1 - S)(W^* + Nf) \\ &= S(Pf.W + Cf - W^* - Nf) + W^* + Nf \end{aligned}$$

The firm will choose that level of W* which minimizes TC. Differentiating TC with respect to W* and setting the result equal to zero, we obtain:

$$\text{(eq.5)} \qquad \begin{aligned} dTC/dW^* &= S'(Pf.W + Cf - Nf - W^*) - S + 1 \\ &= Pf.W + Cf - Nf - W^* + (1 - S)/S' \\ &= 0 \end{aligned}$$

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[26]That is, $S' < 0$. Also, assume that $S'' > 0$.

The above equation can be viewed as an implicit function (F). Differentiating F with respect to W*, we have:

$$\text{(eq.6)} \qquad F_0 = -1 + \frac{(-S')(S') - (S'')(1-S)}{(S')^2} < 0$$

With regards to the other partial derivatives of F, we have:

$$\begin{aligned} F_W &= F_1 = Pf + W(dPf/dW) = ? \\ \text{(eq.7)} \quad F_{Cf} &= F_2 = 1 > 0 \\ F_{Nf} &= F_3 = -1 < 0 \end{aligned}$$

Using the implicit function rule[27], we define:

$$\begin{aligned} \partial W^*/\partial W &= -F_1/F_0 = ? \\ \text{(eq.8)} \quad \partial W^*/\partial Cf &= -F_2/F_0 > 0 \\ \partial W^*/\partial Nf &= -F_3/F_0 < 0 \end{aligned}$$

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[27]See Chiang, 1974. P 220.

Equation 8 implies that the firm's final offer (W*) is positively related to the search cost under the strike mechanism and negatively related to the negotiations search cost. The impact of W on W* is however indeterminate. For mathematical convenience, we assume that W* takes the specific form[28]:

(eq.9) $$W^* = Cf - Nf + g(W), \text{ where } g' = ?$$

Let us now consider the workers' behavior and the occurrence of a strike.

The Workers and Strike Occurrence

We define E as the initial wealth endownment of the workers prior to the start of contract search. Now, if the union loses the strike, its total strike cost is equal to the total amount it has spent in search, Cw. In this case, the post-strike wealth is E minus Cw. On the other hand, if the union wins the strike, its total strike cost is reduced by W, the share of the pie that it receives from the firm. Thus, the post-strike wealth of the workers is E + W - Cw. The workers' expected utility of wealth from the strike mechanism can therefore be written as:

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[28]To complicate this model, one could make W* to be a function of time by assuming that Cf and Nf change over time. In addition, one could also have the workers' counteroffers to influence W*. At this stage, we however feel that our simpler model adds enough new insights to our understanding of strikes.

(eq. 10) $E(ST) = Pw.U(E - Cw + W) + (1 - Pw).U(E - Cw)$

In a similar fashion, we can define the workers' expected utility of wealth from the negotiation process as:

(eq.11) $E(NG) = U(E + Wf - Nw)$,

where Wf is the firm's offer and Nw is the workers' search cost under the negotiation process[29]. In this framework, the workers will prefer the strike mechanism if the following condition is satisfied:

(eq.12) $E(ST) > U(E + Wf - Nw)$.

If equation 12 holds, the workers will reject the firm's offer, Wf, and they will find it to their advantage to go out on strike. This however does not guarantee the occurrence of a strike because as long as Wf is less than W*, the firm will be willing to increase the workers' share of the pie in order to avoid a strike. In other words, if the workers are offerred W*, it is possible that the workers will find the utility from the negotiation process to be higher than the utility from a strike. In this case, a contract will be signed without a strike.

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[29]It is convenient to think of Nw as the total cost of reaching a settlement under the negotiation option.

Thus, for a strike to occur, it must be that

(eq.13) $$E(ST) > U(E + W^* - Nw)$$

When the above condition is met, <u>both</u> parties will find it more viable to opt for the strike mechanism. Thus, contrary to the one-party models (e.g., Ashenfelter and Johnson, 1970, and Hayes, 1984), the occurrence of a strike in the proposed model benefits both parties. They will strike when the benefits from a strike exceed the benefits from the negotiation process. This in turn suggests that a strike here is neither an accident nor a mistake.

By substituting equations 9 and 10 into 13, we can rewrite the condition for strike occurrence as:

(eq.14) $$y = Pw.U(E - Cw + W) - Pw.U(E - Cw) + U(E - Cw) - U(E + Cf - Nf + g(W) - Nw) > 0$$

To determine the impact of W on the occurrence of a strike, differentiate y with respect to W:

(eq.15) $$dy/dW = (dPw/dW)\{U(E - Cw + W) - U(E - Cw)\} - Pw.(dU/dW) - (dU/dg)(dg/dW) = ?$$

The above equation indicates that the effect of W on the occurrence of a strike is indeterminate. In other words, when there is more 'at stake' in a strike, there exist opposing forces which may or may not push the parties into a strike. When there is more to gain in a strike (that is, a high W), the workers may be more willing to go out on strike. This propensity to strike is however partially reduced by the fact that when W is high, the probability that the workers will win the strike is reduced. In the limit, if this probability is zero, the workers will never choose to strike regardless of what is at stake in the strike. Further, when the stakes are high, the firm may be inclined to offer a higher W*, so that the workers' utility of wealth from the negotiation process becomes more favorable. Thus, whether a strike will occur when there is more at stake is an empirical issue.

Let us now examine the impact of search costs (that is, the C's and the N's) on strike occurrence. From equation 10, it is obvious that[30]:

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[30]By definition, the utility from winning a strike should be greater than the expected utility from adopting the strike option since the latter involves the possibility of losing the strike.

(eq.16) $U(E - Cw + W) > E(ST)$

The strike condition of equation 13 can therefore be rewritten as:

(eq.17) $U(E - Cw + W) > U(E + W^* - Nw)$

$> U(E + Cf - Nf + g(W) - Nw).$

In turn, this implies that a strike is likely to occur if[31]:

(eq.18) $W - g(W) > C - N$, where

$C = Cf + Cw$

$N = Nf + Nw$

Other things equal, equation 18 suggests that when the joint search cost under the strike mechanism (that is, C) is low and when the joint search cost under the negotiation process (that is, N) is high, the condition for the occurrence of a strike is likely to be satisfied. That is, the incidence of strikes is positively related to N and negatively related to C[32].

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[31] Because of the two inequalities used to arrive at equation 17, the latter is now only a sufficient condition while equation 13 is both necessary and sufficient.

[32] Given that the 'old' contract usually remains in force during the search period, one would thus expect the party most dissatisfied with the old agreement to have a larger share of N and hence, to have a greater propensity to call forth the use of the strike mechanism. This in turn explains why we have more

At this stage, let us focus on the determinants of these joint search costs. Our basic contention here is that the magnitude of the joint search costs under a particular institution depends upon the effectiveness through which that institution induces the parties to make concessions. The more effective an institution is, the lower the time cost involved in search will be. Ceteris paribus, this should lower the total cost involved in the search for a contract.

To begin with, consider the negotiation process. Broadly defined, the negotiation process can be viewed as periodic formal meetings during which the management and the union representatives attempt to restrict the extent of their disagreement at the bargaining table, and to resolve this conflict in a 'peaceful' manner. In this view, the basic function of the negotiation process is to bring the parties together and to give them an opportunity to interact.

During these interactions, each party attempts to find out about the opponent's view of the future and to change that view so that it lies closer to the party's own prediction. To achieve this objective, the parties typically go through three stages[33]. In the first stage, the interactions help the parties to get acquainted and to learn about the opponent's view. In the second

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[32](cont'd) strikes than lockouts since it is usually the unions which want changes in the status quo.

[33]For a more detailed analysis of these interactions, refer to C.B. Williams (1982).

stage, each party makes concessions on non-essential issues in return for concessions on more important issues by their opponent. This is commonly known as the 'horse-trading' stage. In the final stage, the interactions are more formal and the concessions are more tangible. In addition to these concessions, each party's attempt to change the other party's view is now accompanied by threats of interruption in the negotiation process.

What these interactions suggest is that during the negotiation process, the use of actual economic sanction to force the opponent to make concession is non-existent. Thus, the ability of a party to extract concessions from the other side largely depends upon its own willingness to make concessions in the first place. For example, consider the concession path of the firm. At the start of the negotiation process, the firm will offer a share of the pie, Wf, which is less than W*. It is assumed that during the negotiation process, the rate at which the firm increases its offer over time depends positively upon the concessions made by the union. In other words, the union is able to induce the firm to concede only if it is also willing to make concessionary moves[34].

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[34]It is also possible that credible strike threats by the union may induce the firm to concede. This is however contingent upon whether the demand of the union exceeds W*. If the demand exceeds W*, then credible strike threats will have no bearing on the firm's willingness to concede. Since it is not known whether credible threats are made when the demand of the union exceeds W*, we shall therefore abstract from the impact of strike threats on the concession rate of the parties.

In this paper, it is assumed that the parties' willingness to make the first concession varies inversely with the amount of 'cheating' that has occurred during the terms of the previous contract. That is, if post contractual opportunism by the opponent has been prevalent in the past, neither side will be inclined to make the first concessionary move. A plausible explanation for this reluctance to concede is that quite often post contractual opportunism is not necessarily illegal. As a result, the aggrieved party may be unable to impose costs on the opportunistic party through legal means. In this case, the incentive to make the 'cheater' pay would persist throughout the duration of the contract. This should in turn translate into fewer concessions during the negotiation process.

For example, consider a case where the parties have agreed to a contract which stipulates that the employees should 'dress in a way to reflect the good public image of the company.'. Now, suppose that during the life of the contract, the company introduces a very strict dress code to the dissatisfaction of the workers, and that the arbitration board holds the view that the management has the right to introduce this change. Under these circumstances, we would expect the workers to release their pent-up frustration or dissatisfaction during the negotiation process by holding back their concessions.

In sum, the negotiation process is less effective in inducing the parties to make concessions when post contractual opportunistic behavior is prevalent. As such, the search cost

under the negotiation process (N) will be higher. From equation 18, it follows that we are more likely to observe the occurrence of a strike.

Let us now turn to the search cost under the strike mechanism[35]. Specifically, the focus will be on contract-renewal strikes as opposed to recognition and wildcat strikes. The reason for ignoring the latter is because their occurrence is more likely to exacerbate than to reduce the inherent conflict between the parties[36]. To the employers, wildcat strikes may be viewed as the union's attempt to impose unnecessary costs on them, since the unions not only are breaking the terms of an agreement collectively agreed upon, but also are refusing to opt for the grievance mechanism, which has been set up to solve (peacefully) any grievances that the unions might have[37]. Furthermore, since no notice is given for wildcat strikes, this suggests that the employers are penalised (by the resulting strike costs) without first having a chance to defend their policies or actions. Under these circumstances, it is therefore not surprising that wildcat strikes encourage conflict.

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[35]In the present context, a lockout is also viewed as a strike mechanism.

[36]This may explain why wildcat strikes are illegal in all provinces except for Saskatchewan.

[37]To the extent that more grievances are expected with contracts of long duration, one would therefore also expect more wildcat strikes with such contracts.

On the other hand, contract-renewal strikes discourage conflict and foster concessions[38] for a number of reasons. First, these strikes are far from spontaneous since they can occur only after[39] (1) expiry of contract, (2) bargaining has occurred, (3) a 72 hour notice given, (4) a strike vote taken, and (5) the mediator has booked out. These requirements in effect eliminate any rash decision by either party in their use of the strike mechanism. Thus, the labour code has been designed in such a way that most legal strikes are well thought-out actions by the parties at the bargaining table, so that when these strikes occur, they will usually enhance and speed up the agreement process.

Second, these strikes also serve as an escape valve for releasing the 'tension' that may have developed during the course of the previous contract - that is, strikes provide an opportunity for the parties to penalize their opponent. Thus, where post contractual opportunistic behavior has been prevalent, the strike mechanism may well be the only option that will induce the parties to start making concessions. This conforms with our earlier discussion that when post contractual opportunism is present, the negotiation process is less

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[38]In addition to this basic function, strikes also serve the purpose of providing management with an opportunity to clean and overhaul plant and equipment, providing workers with some time off, supporting or protesting government policies, and so on (Anderson and Gunderson, 1982).

[39]See B.C. Labour Code, Sections 79 to 83.

effective as a means to a settlement, and is therefore less likely to be adopted by the bargaining parties.

Third, since the strike mechanism usually interrupts the parties' flow of income, both sides will therefore have a greater incentive to reach a settlement. In other words, when the strike option is in effect, the per period search cost is increased by the joint strike cost per unit of time (J). This additional economic pressure should increase the concessions made by the parties; and the higher the joint strike cost per unit of time, the higher the expected concession rates of the parties[40].

Thus when the joint strike cost per unit of time is high, the strike mechanism is more effective in inducing the parties to make concessions. It must however be pointed out that the impact of J on the search cost (C) is indeterminate. A high J increases the search cost per unit of time and reduces the duration of search, with the total search cost under the strike mechanism going either direction. In other words, the sign of the derivative of C with respect to J is indeterminate, and from equation 18, this implies that a priori we cannot determine the sign of the relationship between J and the occurrence of a

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[40] In the limit, the additional strike cost can be so high that as soon as a strike is called, an agreement will be reached. Under these circumstances, the duration of the strike is likely to be close to zero. However, it must be pointed out that the parties cannot 'force' the duration to zero because they do not control the magnitude of the strike cost per unit of time. It is assumed to be exogeneous.

strike.

To recapitulate, the proposed model assumes that the strike mechanism and the negotiation process are alternatives through which the bargaining parties can search for a contract. The strike mechanism will be preferred when post contractual opportunism has been prevalent in the past (that is, when N is high, the condition stipulated in equation 19 is likely to be satisfied.). On the other hand, the impact of the joint strike cost per unit of time (J) on the occurrence of a strike is indeterminate, because the relationship between J and C is indeterminate. In addition, the impact of the stake (W) is also a priori indeterminate[41].

The indeterminate relationship between strike and the stake, W, reflects the fact that when the stake is high, the union is likely to be more militant and the firm more conciliatory. Under these circumstances, a strike may or may not occur.

In the literature on strike incidence, it is argued that a negative relationship between strike cost per unit of time and strike frequency is expected because when the cost is high, the parties will have more incentive to avoid a strike. What these studies fail to recognise is that a high per period strike cost also provides the parties with the necessary incentive to reach a settlement, thereby making the strike mechanism a more viable

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[41]See equation 15.

search option. This may explain why contract expiry dates and strikes are usually 'timed' to periods where interruptions to production have the biggest impact.

In the proposed model, we explicitly consider the function of a strike. As such, the relationship between strike frequency and strike cost per unit of time is indeterminate since a high per period strike cost can either increase or decrease the total search cost of a strike. If the resulting total search cost increases, then we would expect less strikes. On the other hand, if the total cost decreases, we would experience more strikes. Thus, if the empirical evidence produces a positive relationship between per period cost and strike frequency, this can be construed as evidence that there is an inverse relationship between per period cost and total search cost - that is, a high per period strike cost will reduce search time by enough so that the total cost of search is lower, thereby increasing the viability of the strike mechanism[42]. Assuming that the per period strike cost is highest at the peak of the cycle[43], it can therefore be argued that the procyclical movement of strike

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[42]This also suggests that the strike mechanism will be more viable if there is an inverse relationship between strike duration and strike cost per unit of time.

[43] The rationale for this asumption is that, ceteris paribus, a strike at the peak of the cycle usually involves a higher daily output loss which in turn should translate into higher loss in profit and wages. These losses would be even higher if the output loss during the strike is picked up by rival firms and/or if the customers have switched permanently to alternative suppliers.

activity is the result of an expressed attempt by the parties to minimize total search costs.

Conversely, if the evidence shows a negative relationship, then it must be the case that a high per period strike cost has a positive impact on total search costs, and as a result, the parties are less inclined to choose the strike option. In this context, we can therefore conclude that the bargaining parties who 'time' their strikes to peak periods are imposing unnecessary costs on to themselves. In this case, the occurrence of a strike is indeed a mistake. Thus, whether a strike is a mistake is an empirical issue. To repeat, a positive estimated relationship between J and strikes would imply that the procyclical movement of strikes is the result of rational behavior by the parties. If the estimated relationship is negative, then procyclical strikes are mistakes.

The positive relationship between post contractual opportunism and strikes is new in the literature. To provide support for this relationship, an empirical model is developed, and this will be the focus of our attention in the remainder of this paper.

V. The Empirical Model.

The model described in the previous section provides an explanation for the incidence of strikes, and its basic hypothesis is that the level of strike activity varies positively with the extent of post contractual opportunistic behavior. The impact of the strike cost per unit of time and of the stake in a strike can however influence the incidence of strikes in either direction.

To operationalize the proposed model, a number of proxies are used. It must be recognised that such an approach is ad hoc since the choice of the proxies has little or no theoretical justification. In most cases, this choice is limited by the availability of data. A preferred approach would have been to measure and use the 'exact' magnitudes of the strike cost, the degree of post contractual opportunism, and the stake in a strike. We shall however not consider this approach since the actual measurement of these variables is impossible.

The Extent of Post Contractual Opportunism.

Our contention here is that the extent of post contractual opportunism can be approximated by the existence of wildcat strikes (WS) and by the size of the bargaining unit.

The occurrence of a strike during the terms of a contract usually suggests that post contractual opportunism is at its

extreme. This is expected to decrease the effectiveness of the negotiation process as a search mechanism, and accordingly the parties are more likely to choose the strike option when the contract is up for renewal. Thus, the coefficent on WS in the strike equation is expected to be positive.

With regard to the size of the bargaining unit, we hypothesize that in large bargaining units, 'tight' contracts are too costly to develop. As such, one would expect more room for cheating in large plants. This should, at the end of the bargaining contract, translate into a higher strike probability. That is, a positive coefficient on SIZE is expected.

The Stake of the Strike.

As a first approximation, we measure the stake of a strike for a particular bargaining pair by the value of their output[1]. Higher output suggests that the 'pie' to be divided between the parties is higher. In turn, this implies that there is more at stake in a strike. A priori, the relationship between strikes and relative value added (VA), defined as the value added of a bargaining pair relative to that of the industry, is indeterminate.

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[1]One can also use output per worker but for reasons to be discussed later, the absolute proxy seems preferable.

The Joint Strike Cost per unit of time.

The joint strike cost per unit of time can be defined as the daily monetary and nonmonetary losses suffered by both the workers and the employer as a result of a strike. It includes not only the losses occurred during a strike but also any additional losses or offsetting gains that may arise during the pre and post strike periods. Thus, in determining the proxies for cost, we paid special attention to those proxies which can capture the pre and post strike effects. In total, we have four per period strike cost proxies. They are (i) relative value added, (ii) intra year variations in shipments, (iii) intra year variations in inventories, and (iv) an index measuring the predictability of mandays lost due to industrial conflict.

Because the relationship between the per period strike cost (J) and the occurrence of a strike is a priori indeterminate, the expected signs on these proxies are also indeterminate. The estimated signs will however allow us to determine whether the procyclical movement of strikes is rational behavior. If the proxy is positively related to J, then a positive estimated coefficient on that proxy would imply rational procyclical strikes. Similarly, if the proxy is negatively related to J, then a negative relationship between that proxy and the occurrence of strikes would also imply that the procyclical movement of strikes is a calculated move.

For a given impact of a strike on the operation of an

enterprise, the joint cost of a strike[2] should be higher for those bargaining pairs whose daily output is high because they stand to lose more than those with lower output. To capture this effect, R and N used wages per worker. In this paper, we shall instead use the value added of the firm relative to that of the industry for two reasons. First, we already have the data on this proxy[3]. Second and perhaps more important, the per worker proxy does not capture the actual magnitude of output loss suffered by the firm. For example, consider two firms, A and B, with 100 and 1000 workers respectively. Suppose that the productivity of the workers are the same in both firms. It should be obvious that because of its larger size, firm B should suffer a higher output loss per unit of time than A in the event of a strike. If we used R and N's measure, we would have erroneously indicated that both firms have the same output loss per unit of time.

The higher the relative value added, the higher is the expected strike cost to both parties. Thus, a positive coefficient on VA would imply rational strikes while a negative coefficient would indicate that the occurrence of a strike at the peak of the business cycle is a mistake.

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[2]Unless otherwise defined, joint strike cost, strike cost and joint strike cost per unit of time are hereafter used interchangeably.

[3]In other words, the variable VA is used as a proxy for both the stake in a strike and the strike cost per unit of time.

With regard to the intra year variations in inventories of finished products (INV), R and N argue that given shipments, a high INV implies a greater ability by the producers to substitute inputs across time. In turn, this implies a lower strike cost for both parties since the production loss during the strike can be largely offset by overtime production before and after the strike.

The position adopted in this paper is that the relationship between INV and strike cost is an empirical question, depending on the sign of the correlation between inventories and shipments of finished goods. If the latter are negatively correlated, then when shipments rise over the business cycle, inventories should fall. In other words, inventories are used up to 'smooth out' fluctuations in shipments. In turn, this suggests that inventories can also be used as a buffer against shocks from the input sector. Accordingly, high variability in inventories, given shipments, implies a greater ability to maintain a steady stream of output to customers, and thus a lower strike cost[4].

On the other hand, if inventories and shipments are positively correlated, then the movement of inventories over time is simply a reflection of the seasonality in demand and does not indicate the use of inventories to smooth out shocks from either the input or the output sectors. In this case, a

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[4]This argument implicitly assumes that the firm is able to continue its sales during a strike. But where picket lines are strategically placed, a high INV may have no bearing on the firm's ability to cushion itself against a strike shock.

high INV suggests that the firm is subject to wide fluctuations or seasonality in demand. Now, to the extent that strikes are usually timed to peak periods, it can therefore be argued that strikes which affect bargaining pairs exhibiting the characteristic of a high INV are usually costly. Hence, when inventories and shipments are positively correlated, a high INV is associated with a high strike cost.

To test the relationship between INV and strike cost, we estimated the correlation between inventories and shipments for each of the 19 industries in our sample. For all industries, the sample length is from 1960 1 to 1977 12, and both the inventories and shipments series are 'detrended'. In all cases, the estimated correlation coefficients are positive[5], thereby suggesting that for our data set, a high INV implies a high strike cost.

Thus, in this paper, it is assumed that there is a positive relationship between INV and strike cost per unit of time (J). Hence, a positive estimated coefficient on INV in the strike equation would imply that the procyclical movement of strikes is rational behavior.

The intrayear variation in shipments of finished products (SHIP) enters the strike equation as a proxy for the premium attached to the timeliness of delivery. Other things equal, a firm prefers to ship its products in a steady fashion (that is,

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[5]See appendix A.

low value of SHIP) since this would entail lower shipping costs. Thus, for a firm to ship its products in a fluctuating fashion and hence incur the extra shipping costs, it must be because the firm places great importance in meeting its customers' demands on time. Under these circumstances, a strike, which usually delays delivery, is costly. The variation in shipments and the strike costs are therefore positively related. Thus, if the estimated relationship between SHIP and strikes is positive, then procyclical strikes are the result of rational moves by the parties.

With regard to the predictability of a strike, our basic contention is that prior to the start of a strike, the parties will attempt to predict the expected mandays lost in order to minimize the strike cost. The more accurate they are in their prediction, the better prepared they will be. Hence, the joint strike cost will be smaller. For example, if the parties can correctly predict that a particular strike will be lengthy, they can both minimize the cost, with the workers seeking alternative employment and the employer advising its customers to stock up prior to the start of the strike. Conversely, if the parties incorrectly predicted that a strike would be lengthy, their behavior would discourage potential customers, and thus increase the strike cost. These examples therefore suggest that a high forecast error (FOR) is associated with a high strike cost. Thus a positive coefficient on FOR would imply rational strikes.

To recapitulate, the proposed strike equation is:

$$(eq.1) \qquad S_{it} = a0 + a1 * WS_{it} + a2 * SIZE_{it} \pm a3 * VA_{it} \pm a4 * SHIP_{it} \pm a5 * INV_{it} \pm a6 * FOR_{it},$$

where i stands for the ith bargaining pair, t for time, WS for a dummy variable representing the presence of wildcat strikes, SIZE for the size of the bargaining unit, VA for the value added of the firm relative to that of the industry, SHIP for the intrayear variations in shipments, INV for the intrayear variations in inventories, and FOR for an index measuring the magnitude of the forecast error in predicting total mandays lost due to strikes.

VI. Data Measurement

To estimate the strike equation, a sample of 1264 expired bargaining contracts from 19 2-digit SIC manufacturing industries (all except for the 'miscellaneous' category) over the period 1974-1976 is used[1]. Each individual contract is considered to represent a particular bargaining pair, and the object of this study is to determine the circumstances under which the search for a contract will lead to a strike. In theory, the explanatory variables should be measured at the micro level, but since such data are not readily available, we are compelled to measure all right hand side variables with the exception of WS and SIZE at the industry level. Implicitly, we are therefore assuming that all bargaining pairs in an industry are identical in the sense that the industry's conditions prevailing at the time the contract expired affect them to the same extent. Thus, if the strike cost is high in an industry, we assume that all the bargaining pairs in that industry are also faced with a high strike cost.

The Dependent Variable.

In the theoretical model, we made no attempt to explain the impact that a strike may have on the economy. Instead, our

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[1]The sources for the data are discussed appendix B.

primary concern is to explain when a particular pair will choose the strike mechanism. For strike models like ours, Skeels (1971) suggests that the appropriate strike variable must be a decisional measure of industrial conflict, which is best approximated at the aggregate level by the number of strikes divided by the number of expired agreements. At the micro level, this measure is therefore a 0-1 dummy variable, taking on the value 1 for those expired contracts which ended up in a strike. We have accordingly used this measure for our strike variable, S.

The Wildcat Strikes.

WS is also a 0-1 dummy variable and it is equal to 1 for those bargaining pairs who have experienced a wildcat strike in the three years prior to the time the contract expired. We chose three years as the cut-off point for the institutional reason that there are virtually no contract lasting more than three years. Thus, if a wildcat strike occurred four years ago, we assume it will not affect the present bargaining process since any "tension" resulting from that strike has already been released in the previous bargaining process.

The Size of the Bargaining Unit.

We approximate the size of the bargaining unit by the number of workers covered in its collective agreement. On the

basis of the proposed model, a positive relationship between large coverage and strikes is anticipated.

Relative Value Added.

Relative value added is defined as an industry's value added divided by the value added of all (manufacturing) industries. Thus, the higher is VA, the costlier it is for the bargaining pairs in that industry to have their productive resouces sit idle. VA also measures the stake in a strike.

The Intrayear Variations in Shipments and Inventories.

The intrayear variation in shipments (SHIP) is defined as the intrayear standard deviation in finished products shipments divided by its mean. The intrayear variation in inventories (INV) is also defined in this fashion. Data on both SHIP and INV are available only at the industry level. Thus, in estimating the model, we assume that all the bargaining pairs in an industry with a high INV and SHIP are also faced with such characteristics.

It should also be noted that there is a possible problem of reverse causality between these two variables and the dependent variable, STRIKE. That is, high values of SHIP and INV not only affect the occurrence of a strike but are also affected by a strike. Therefore, if we are to regress contemporaneous values of SHIP and INV on STRIKE, the estimated coefficients will

incorrectly pick up the effect that a strike has on the values of SHIP and INV.

To avoid this problem we shall use the lagged values of SHIP and INV. This should remove the reverse causality problem since a strike in year t should have no effect on the previous year's variations in shipments and inventories.

The Forecast Error.

The forecast error variable (FOR) is a proxy for measuring the degree of accuracy in predicting mandays lost due to strikes. The larger is FOR, the costlier it is for any bargaining pair to take a strike. This variable cannot be measured at the micro level. To resolve this problem, we therefore assume that all individual bargaining pairs in a given industry at time t have less forecasting ability if at time t-1, there is a large discrepancy between the industry's actual mandays lost and its forecasted values. Conversely, if the industry's forecast error is smaller at time t-1, we then assume that the bargaining pairs at time t are better at predicting mandays lost, and hence experience a smaller strike cost.

As a first approximation, we assume that the forecasts of mandays lost are generated using the univariate-autoregressive integrated-moving-average (ARIMA) model. The general expression from this model is given as:

$$(\text{eq.1}) \qquad L(B)g(B)(1-Bs)^{D}(1-B)^{d}MDL_t = F(B)h(B)e_t ,$$

where MDL is the mandays lost due to strikes, B and Bs are the backshift operators for the nonseasonal and seasonal components, e is a white noise error term, D is the seasonal difference, d is the nonseasonal difference, L(B) and F(B) are the seasonal autoregressive and moving average terms respectively while g(B) and h(B) are their nonseasonal counterparts.

From the above expression, the forecast for mandays lost is therefore estimated solely on the basis of its historical values. It is possible that the inclusion of other variables may help improve the forecast. But for simplicity, let us assume that the cost of gathering information for a multivariate time series model will exceed the marginal benefits from using such a model[2].

To generate the necessary forecasts, data on mandays lost (in thousands) due to industrial disputes for 19 2-digit SIC manufacturing industries are used. The sample size for each of these series consists of 216 monthly observations, ranging from January 1962 to December 1976.

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[2]This is especially true for short-range forecasts where the ad hoc model usually performs as well as the more sophisticated model.

For each industry, we constructed an appropriate univariate ARIMA model by following the procedures suggested by Box and Jenkins. The first step was to check for the stationarity of the series, which was done by looking at the autocorrelation functions for the series. In most industries, the ACF suggests the existence of seasonality in the mandays lost series. Accordingly, we differenced these series with lags of 12, and the ACF for the differenced series suggested stationarity.

The next step was to determine the moving average and the autoregressive parts of the model. Several alternative specifications were estimated and those which passed the diagnostic checking were saved for forecasting purposes. For any model to pass the diagnostic checking stage, we required the following : (i) a t-value exceeding 2 for all the estimated coefficients, (ii) a chi-squared value of less than 18 at lag 36 to ensure that the residuals are white noise, and (iii) the sum of the autoregressive parameters to be less than one, so that the stationarity condition is satisfied.

Finally, using the models which passed the diagnostic check, we generated a number of monthly forecasts for the period January 1973 through December 1975. We then chose that model which had the lowest absolute forecast error over the forecast range. We repeated this same procedure for each industry, and in the end, we had 19 ARIMA models, one for each industry[3]. To

[3]See appendix C for the specific ARIMA model used for each industry.

obtain the data for the FOR variable, we used the following equation[4]:

(eq.2) $$FOR_{iT} = \#\{(|A_{itT} - F_{itT}| / A_{itT}) * 100\} / 12,$$

where # stands for summation sign from t=1 to t=12,

i stands for the ith industry,

T stands for the year,

t for the month,

A is the actual mandays lost, and

F is the forecast mandays lost.

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[4]We used the absolute value of the forecast error because as discussed earlier, both underestimating and overestimating the mandays lost of a particular strike should cause the joint strike cost to be higher.

VII. The Estimation Procedure.

For convenience, let us denote the proposed strike equation as:

(eq.1) $\quad STRIKE = X\beta + U$, where

STRIKE is an N*1 column vector representing N observations of the strike dummy variable, X is an N*K matrix representing K explanatory variables, β is a K*1 column vector of K different β's, and U is an N*1 column vector of disturbance terms. Since STRIKE is a 0-1 dummy variable, its predicted value given X can therefore be interpreted as describing the probability (S) that a particular bargaining pair will choose the strike mechanism[1]. In effect, this implies that the estimated values of the β's can be used to calculate the probability of a strike, given the values of X.

Given this interpretation, an OLS regression or any other regressions falling into the class of linear probability model is no longer appropriate because the estimated coefficients can generate a strike probability falling outside the 0-1 range[2].

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[1] See Pindyck and Rubinfeld, 1981. Chap 10.

[2]Another problem with the OLS regression is that the error term is heteroscedastic - that is, the variance of the error term is no longer constant.

The estimated equation of the OLS regression can be written as:

$$S = X\beta^{ols}, \qquad \text{(eq.2)}$$

and it should be obvious that since there are no constraints on the values of X and the OLS estimated coefficients, it is possible for the strike probability to be negative or greater than one.

To overcome this problem, the standard approach is to transform X such that:

$$S = F(X\beta^*) \qquad \text{(eq.3)}$$

falls between the value of 0 and 1[3]. The two most common transformations used are the cumulative normal function and the cumulative logistic function. If we use the former as the transformation function, then the strike probability can be denoted as[4]:

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[3]Depending on the transformation function, β^* usually involves nonlinear estimation and as such, cannot be estimated by the OLS technique.

[4]See P and R, P 282.

$$\text{(eq.4)} \qquad S = (1/\sqrt{2\pi}) \int_{-\infty}^{X\beta^*} e^{-Z^2/2}\, dZ, \text{ where}$$

Z is a random normal variable which is normally distributed with mean zero and unit variance. If we use the logistic function, the strike probability is:

$$\text{(eq.5)} \qquad S = 1/(1 + e^{-X\beta^*})$$

In both cases, regardless of the magnitudes of X and of the estimated coefficients β^*, the distribution of the strike probability will have an S-shape, falling between the values of 0 and 1.

With the exception of some special cases, the usual technique for estimating β^* is that of maximum likelihood, which involves finding a β^* that maximizes the probability (or likelihood) of obtaining the observed data[5]. In other words, this technique estimates a β^* which maximizes the likelihood function. If we arrange the dependent variable so that the first n observations are associated with the occurrence of a strike and assume independence among observations, then the likelihood

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[5]Kennedy, 1979. P 21.

function for the problem at hand can be expressed as:

(eq.6) $$L = S_1 \ldots\ldots S_n (1-S_{n+1}) \ldots\ldots (1-S_N)$$, where

S_1 is the probability of a strike for the first bargaining pair in the list of those who actually went out on strike, while $(1-S_{n+1})$ is the probability of no strike for the first bargaining pair heading the list of those who actually reached a settlement without striking.

If we substitute equation 4 into 6, and choose that β^* which maximizes the logarithm of L, then β^* is the maximum likelihood estimate of the probit model. Similarly, if we substitute equation 5 into 6, the resulting estimate of β^* is the MLE estimate of the logit model. For the purpose of this paper, we shall use these two methods of estimating β^*, and the results are presented in the next section.

VIII. The Empirical Results.

The initial results of the strike equation are reported in table I. They provide strong support for the hypotheses advanced in Section V. In both the logit and the probit analyses, the coefficients for each of the independent variables with the exception of SIZE are statistically significant.

TABLE I.

	The Logit Results.		The Probit Results.	
	Coef. Estimate	T-Stat.	Coef. Estimate.	T-Stat.
Constant	-0.76	-4.8	-1.4	-5.7
SHIP	0.02	2.2	0.03	2.2
INV	0.04	5.2	0.06	5.3
FOR	0.01	2.7	0.01	3.1
VA	-0.05	-2.8	-0.06	-2.7
SIZE	-0.000015	-0.1	-0.000037	-0.1
WS	0.60	4.8	0.94	4.8

The coefficient on SIZE is insignificant and has the wrong sign. At first glance, this may be due to the collinearity between SIZE and VA. In general, multicollinearity is a serious problem if adding a new (collinear) variable to the estimating equation reduces the significance and/or alter the signs of

already included variables[1]. To test for the severity of the multicollinearity problem in our model, we reran the strike equation without SIZE. The results are presented in table II, and it appears that the presence (or the absence) of the SIZE variable has no effect on the sign and significance of the other explanatory variables. We can therefore assume that the problem of multicollinearity is not severe in our case[2]. This in turn implies that we cannot resort to the collinearity problem between VA and SIZE to explain the sign reversal on SIZE.

TABLE II.

	The Logit Results.		The Probit Results.	
	Coef. Estimate	T-Stat.	Coef. Estimate.	T-Stat.
Constant	-1.39	-5.8	-0.77	-4.8
SHIP	0.03	2.2	0.02	2.1
INV	0.06	5.3	0.04	5.2
FOR	0.01	3.1	0.01	2.7
VA	-0.07	-2.7	-0.04	-2.8
WS	0.94	4.8	0.59	4.8

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[1]See Kennedy, 1979. P 131.

[2]This assumption can also be justified on the basis of the low correlation between (0.036) between VA and SIZE. This low correlation coefficient is probably due to the fact that VA is measured at the industry level and SIZE at the bargaining unit level.

At the theoretical level, a plausible explanation for the negative sign of SIZE is that in large bargaining units, the parties have at their disposal more resources to make use of professional services. Assuming that professionals are in a better capacity to sign a more 'precise' contract, we can therefore argue, contrary to our original hypothesis, that in large bargaining units, there is less room for post-contractual opportunism. In turn, this implies less strikes. We however do not have any explanation for why it is statistically insignificant.

From tables I and II, it should also be obvious that both the logit and probit models yield similar and consistent results. In both cases, the signs and the statistical significance of the estimated coefficients are similar. Further, both models consider the existence of wildcat strikes as the most important predictor of strike probability while the size of the bargaining unit is considered the least important. On this basis, there is no reason given our data set to prefer the logit model over the probit model, or vice versa.

Let us now consider the implications that can be derived from the signs of the statistically significant coefficients. The negative sign on VA implies that when the 'stake' is high, the concessions made by the firm (to avoid a strike) are enough to counter the rise in the militancy of the workers. In comparison to other studies in the literature, the result on VA appears to follow the same pattern. For example, Reder and

Neumann (1981) using relative wages as a proxy for relative value added also obtained a negative sign.

The positive sign on WS supports the hypothesis that the occurrence of a strike during the term of a contract is an extreme form of post-contractual opportunistic behavior. Under these circumstances, the negotiation process is unlikely to generate a settlement and as a result, there will be a tendency for the parties to switch over to the strike mechanism as a means to settlement.

The positive signs on SHIP, INV and FOR suggest that joint strike cost per unit of time and the likelihood of a strike are positively related. A number of implications can be derived from this result. First, one can argue that the empirical evidence refutes Reder and Neumann's basic hypothesis that when the joint strike cost is high, the parties are likely to develop a complex protocol, and hence experience less strikes. Second, in our theoretical framework, it was hypothesized that we would expect a positive relationship between J and the occurrence of a strike if a rise in J reduces the search time by enough so that the total search cost is also reduced. Our estimated positive signs on the strike cost proxies indicate that this is indeed the case. This implies that those bargaining pairs who 'time' the occurrence of a strike to concur with boom times are in effect minimizing the total costs involved in the search for a contract. In other words, the procyclical movement of strikes is the result of economically rational behavior by the parties.

Third, the results also suggest that in their decision to strike, the bargaining parties do take into account the strike costs. This in turn provides empirical support for the criticism that the model developed by Kaufman is incomplete since in his model, the occurrence of a strike depends primarily upon the costs of the negotiation process.

A survey of the literature on strike incidence would show that both WS and FOR are new explanatory variables. Given that the proposed model is responsible for introducing them, a statistically insignificant estimate of these variables could have been interpreted as a refutation of the proposed model. On the basis of the results provided in the previous tables, we can therefore argue that the empirical evidence provides strong support for our model.

In so far as SHIP and INV are concerned, the estimated signs contradict the results of two other studies which have used similar explanatory variables. Reder and Neumann (1981) had a positive sign on INV and a negative sign of SHIP, while Maki and Strand (1984) estimated a negative sign for INV and a positive sign for SHIP. There may be a number of explanations for these conflicting results. First, the dependent variable is measured differently. In R and N, the dependent variable is 2 and 3 year averages while in Maki and Strand, it is on an annual basis. Our left-hand side variable is also on an annual basis. The level of aggregation is however at the firm level while in M and S, 2-digit (SIC) industries were used. Second, our

mathematical definition of SHIP and INV is similar to M and S but different from R and N. Third, it is possible that the set of years used in measuring INV and SHIP can influence the estimates of these coefficients. Sensitivity analysis by R and N however does not lend much support to this view.

To examine the effect of the individual explanatory variables on the probability of a strike, let us focus on the logit model[3]. The strike probability under the logit model can be written as[4]:

$$\text{(eq.1)} \qquad S = 1/(1 + e^{-X\beta^*})$$

Rearranging the terms, equation 1 can be defined as:

$$\text{(eq.2)} \qquad \text{Ln}(S/(1-S)) = X\beta^*$$

From the above, it should be clear that the estimated logit coefficients measure the impact of a change in X on the logorithm of the odds that a strike will occur. To determine the impact of a change in say X_1 on the actual strike probability

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[3]We chose the logit model for mathematical simplicity. With this model, we only have to solve for a logarithmic equation. In contrast, the probit model would have meant solving for a cumulative density function.

[4]See equation 5, section VII of this paper.

involves a number of steps necessary to convert the estimated coefficients into an 'appropriate' form.

From equation 1, a unit or percent change in X_1 (that is, the change in X_1 is the numeraire) implies that the 'new' strike probability can be expressed as:

$$\text{(eq.3)} \qquad S' = 1/(1 + e^{-X\beta^* - b_1}),$$

b_1 is the logistic coefficient of X_1. The change in S for a one-unit change in X_1 is therefore:

$$\text{(eq.4)} \qquad dS = 1/(1 + e^{-X\beta^* - b_1}) - S$$

The above equation implies that the change in the probability of a strike is a function of the probability itself, because $X\beta^*$, from equation 2, is a function of S. For example, if S = 5%, then $X\beta^* = -2.944$. Thus, to determine dS, we need to assume that the value of S is given, and for this paper, we shall evaluate dS at three different levels of strike probability - 5%, 50%, and 90%[5].

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[5]For our data set, the number of strikes divided by the number of expired contracts, expressed as a percentage, is about 12%.

Using the estimated logit coefficients from Table II, the change in the probability of a strike, expressed as a percent, for a given unit change in an explanatory variable is presented in the following table:

TABLE III.

Strike Prob.	SHIP	INV	FOR	VA	WS
S = 5%	0.2	0.6	0.1	-0.3	7.0
S = 50%	0.8	1.5	0.2	-1.7	22.0
S = 90%	0.3	0.5	0.1	-0.6	5.8

As expected, the % change in the probability of striking varies with the different levels of strike probability. In all cases, the % change is highest when the probability of a strike is 50%.

The results in table III suggest that WS and FOR are the most meaningfully significant predictors of strikes while SHIP and INV are the least significant predictors[6]. For example, for an underlying strike probability of 5%, the occurrence of a wildcat strike will increase that probability to 12%. Similarly,

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[6]McCloskey (1985) argued that a meaningfully significant predictor is not only statistically significant but also significant in an economic sense.

a 40% error in predicting total mandays lost due to workstoppages will increase the strike probability from 5% to 9%. On the other hand, the variable SHIP is not economically significant since it is unlikely to change the strike probability from 5% to 6%. The same applies for INV.

For future research, I intend to re-test the model developed in this paper with a more refined database. It would also be interesting to develop a multivariate ARIMA model for the FOR variable and examine if the more sophisticated version of FOR has a more significant influence of strikes. Finally, depending upon the availability of other data set, I intend to carry a non-nested test between the variables used in our strike equation and the 'other' variables commonly found in the literature.

IX. Concluding Remarks

A model of strike incidence was developed, and in the proposed framework, the occurrence of a strike is hypothesized to depend upon the stake in the strike, the prevalence of post-contractual opportunistic behavior and the magnitude of the joint strike cost per unit of time. The impact of these variables was tested across 1264 individual bargaining units, using both logit and probit analyses. In both cases, the results provide strong support for the hypotheses advanced in the theory.

The theoretical model contains some unique features that distinguish it from the literature on strike activity. While there exist a number of studies (for example, Kaufman, 1981) which view the strike mechanism as beneficial to <u>both</u> parties, the present study is however the only study within this category to show that the occurrence of a strike depends not only on the ineffectiveness of the negotiation process but also upon the effectiveness of the strike itself.

It also appears that we are the first to introduce the concept of post-contractual opportunism as an explanation of strike activity. Further, following the study by Reder and Neumann (1980), the general consensus in the literature is that strikes and joint strike cost per unit of strike activity are inversely related, because when strike cost is high, the bargaining parties are more inclined to avoid a strike. We

depart from this view by arguing that a high strike cost also makes the strike mechanism more effective as a means to settlement[1]. As such, the relationship between strike cost and strike occurrence is a priori indeterminate.

With regard to the empirical analysis, our estimating equation contains two variables - wildcat strikes and forecast error - which, to my knowledge, have never been used as explanatory variables. The empirical results suggest a strong relationship between wildcat strikes and contract renewal strikes.

The results also suggest a positive impact of joint strike cost on the occurrence of a strike. This in turn implies that the procyclical movement of strike activity is the result of rational behavior by the parties in the sense that when they 'time' the occurrence of a strike to boom times, they are in effect minimizing the total costs involved in the search for a contract. Among the public policy implications that can be derived from this particular result are the following:

First, to encourage the use of the negotiation process, public policies should be directed towards reducing the joint strike cost per unit of time. Such policies would reduce the effectiveness of the strike mechanism as a means to settlement,

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[1]Empirical support for this argument stems from the observed procyclical movement of strike activity, which suggests that bargaining parties prefer to use the strike mechanism when per period strike cost is at its peak. Implicitly, this indicates that there exists an inverse relationship between per period strike cost and strike duration.

and hence induce the parties to seek alternative means of conflict settlement.

Second, to the extent that the effectiveness of collective bargaining is enhanced with high per period costs to both parties, it appears that there is a need for a third settlement mechanism. At the present time, the bargaining parties are faced with an all-or-nothing situation. If they choose the negotiation process, their per period bargaining costs are kept to a minimum. On the other hand, if they strike, their costs take a sudden jump, resulting from the shutdown of their operations. It may be the case that the per period cost under the negotiation process is too low for effective bargaining while the per period strike cost is unnecessarily high for inducing the parties to a settlement. As a result, it seems appropriate that a third alternative be made available to the parties, so that they can gradually experience rising per period cost. This would allow them to 'choose' the optimum per period cost necessary for a collective agreement. One such alternative would be what Weiler (1980) called a 'Graduated Strike', where the extent of the shutdown increases over time.

APPENDIX A

The following table provides the estimated correlation coefficents between inventories and shipments[1] for the 19 2-digit SIC manufacturing industries in our sample:

Table I.

Industries:	Correlation coef:
Food & Beverages	0.89
Tobacco Products	0.39
Rubber	0.83
Leather	0.36
Textile	0.53
Knitting Mills	0.26
Clothing	0.46
Wood	0.71
Furniture & Fixtures	0.70
Paper & Allied Ind	0.76
Printing, Publishing & Allied Ind	0.56
Primary Metal	0.77
Metal Fabricating	0.86
Machinery	0.80
Transportation Equipment	0.59
Electrical Products	0.65
Nonmetallic mineral products	0.60
Petroleum and Coal products	0.46
Chemical and Chemical products	0.86

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[1]Both series are 'detrended' series. That is, they are the residuals from regressing the original series against a constant and a time trend.

APPENDIX B

In this appendix, the sources for the data used in our empirical tests are discussed.

The Dependent Variable.

The dependent variable is a 0-1 dummy variable which takes on the value of 1 if for a particular expired contract, the strike mechanism was used to generate a new contract. The dependent variable therefore required data on agreements expiring and on strikes at the micro level.

The primary source for the expiry data was the tape, Bargaining History for Contracts Covering 200 Workers or Over, 1967-1977, which lists expired contracts at the bargaining unit level. This list was supplemented by additional data from various issues of the Collective Bargaining Review, and in total, we had 1264 expired contracts for the period 1974 - 76.

The source for the strike data was Strikes and lockouts in Canada, Department of Labour, Canada. This source lists work stoppages at the micro level and the major issues involved with such stoppages. For our purpose, we only considered those work stoppages arising from issues that appear to be bargaining issues - for example, the wage issue. These stoppages were then matched against the expiry list. Where a match was found, that particular expired contract takes on the value of 1, and 0 otherwise. A number of work stoppages did not have matching expired contracts, and they have been discarded.

The Independent Variables.

VA is the value added of a particular three-digit industry divided by the valued added of the one-digit (SIC) manufacturing industry. The data source is Statistics Canada, Catalogue number 31-203.

WS is a dummy variable which takes on the value of 1 for those units on our expiry list which have experienced a wildcat strike in the last three years prior to the expiry of the contract. The source for this variable was Strikes and lockouts in Canada, and for a work stoppage from this source to be classified as a wildcat strike, it must have no matching expiry agreement and the issues involved are different from those that would normally arise from bargaining - for example, the re-instatement of a fired worker. Where the issues are not clear-cut, a wildcat strike must be of short duration, and we have arbitrarily chosen 48 hours as the cut-off point.

SIZE is the number of workers covered in a collective agreement. The sources for this variable are the Collective Bargaining Review and the tape Bargaining History for Contracts Covering 200 Workers and Over, 1967- 77.

INV and SHIP are the intra year coefficients of variation in inventories and shipments respectively. Data on inventories and shipments were obtained from Statistics Canada, Catalogue Number 31-001.

FOR is the absolute magnitude of the forecast error, resulting from forecasting total mandays lost due to work stoppages on the basis of a univariate ARIMA model. The source for mandays lost is Canadian Statistical Review, Statistics Canada, Catalogue number 11-003.

APPENDIX C

The ARIMA models used to generate the forecast error for each industry in our data set are[1]:

Table I.

Industries:	ARIMA Models:
Food & Beverages	(001)(011)
Tobacco Products	(100)(000)
Rubber	(100)(011)
Leather	(100)(000)
Textile	(101)(000)
Knitting Mills	(100)(000)
Clothing	(000)(000)
Wood	(001)(011)
Furniture & Fixtures	(100)(001)
Paper & Allied Ind	(101)(100)
Printing, Publishing & Allied Ind	(100)(000)
Primary Metal	(101)(000)
Metal Fabricating	(100)(011)
Machinery	(101)(000)
Transportation Equipment	(101)(000)
Electrical Products	(200)(011)
Nonmetallic mineral products	(101)(100)
Petroleum and Coal products	(100)(000)
Chemical and Chemical products	(101)(000)

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[1]Using conventional notation, our ARIMA models are identified as (pdq)(PDQ), where (pdq) identifies the nonseasonal and (PDQ) the seasonal model. The p's (that is, both small p and capital P) stands for the autoregressive process, d's for the differencing and q's for the moving average process.

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