STRIKE ACTIVITY AND INFLATION IN
AUSTRALIA

by

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Tony Phipps
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1. INTRODUCTION

The connections between strike activity and inflation are of great social, political and economic importance. The general public seems to feel, rightly we believe, that there are strong relationships between strike activity and inflation. However, the way in which these relationships are viewed is more the product of political dogma than of systematic research. This paper constitutes a modest first attempt to unravel the connections between strike activity and inflation as they have manifested themselves in the Australian economy. It has been prompted by two fundamental problems and a number of associated questions.

The first problem is that industrial disputes and work stoppages receive a great deal of attention from the news media and are, as a result, the most obvious public manifestation of trade union activity. Nevertheless, the reasons for strike activity are shrouded in apprehension and bigotry. This suggests a number of simple questions. Are a majority of strikes in Australia the result of "irrational behaviour" or "faulty negotiation", as many would have us believe, or do they result from the "rational behaviour" of trade unions and firms within a basically market economy? What has been the impact of inflation on strike activity? Has there been a general increase in trade union militancy?

The second major problem area relates to the postulated impact of trade unions on the rate of change of aggregate money wages. This prompts a second sort of question. Have changes in trade union "power" or "aggressiveness", as indicated by changes in strike activity, had a significant impact on the rate of change of money wages in Australia?

Because it is conceivable that aggregate strike activity both impinges upon inflation and is itself affected by inflation, the questions above cannot be answered separately. We know that rapid inflation tends to be associated with high industrial unrest. However, this strong, positive association tells us nothing about the direction of causation.

A priori, a number of possibilities may be envisaged. First, increased union activity, in the form of successful strikes, may push up the rate of change of money wages which, in turn, increases the rate of change of prices, other things being equal. Here union militancy may be viewed as one fundamental cause of inflation, though: the problem of explaining changes in union militancy remains. Secondly, union activity may rise in response to an increase in the rate of change of prices which is undermining real wages. Strike activity may
here be viewed as an attempt to ensure that rising prices are translated into rising money wages so that union members' real wages are at least maintained. More particularly, strikes may increase with rising inflation because managements cautiously underestimate future price rises and unions, again cautiously, overestimate future price rises. Union demands aimed at maintaining expected real wages will then exceed firms' expected ability to pay, resulting in strikes. The strikes may reconcile divergent union and employer expectations about the future rate of price increase. Thirdly, inflation and strike activity may vary together because they are both influenced by some other factor, say excess demands in goods and labour markets. When the labour market tightens a union's bargaining position strengthens which may increase its propensity to strike. Simultaneously, the emergence of excess demands in goods and labour markets will increase the rates of price and wage inflation. Fourthly, of course, the observed association may result from any combination of the causal relationships postulated above.

It is clear that, in trying to unravel the causal elements in the association between strike activity and inflation, we are faced with a classic simultaneous equation problem. Consequently, this paper attempts to specify and estimate simultaneously the various interrelationships between strikes and inflation in Australia, within the context of a simple, three-equation model. The first equation tries to explain aggregate strike activity in Australia, partly in terms of the rate of inflation; the second tries to explain the rate of change of money wages, partly in terms of the level of strike activity; and the third tries to explain the rate of change of retail prices.

The rest of the paper takes the following form: In Part II, we specify, with some alteration and elaboration, a model which has been used successfully to account for strike activity in the U.S.A. and U.K. Part III contains an analysis of the wage/price sector of the model. Empirical estimates of the strike/wage/price model are presented in Part IV. Tentative conclusions are contained in Part V.

II A MODEL OF STRIKE ACTIVITY

(1) General Introduction: the Aschenfelter and Johnson Approach

Bentley and Hughes [3] have produced substantial statistical evidence to support the view that strike activity in Australia has varied directly with the business cycle. This evidence is in accord with that for a number of other industrialized, market economies. However, as Bentley and Hughes admit the most serious limitation of their paper is that it fails "to disentangle the
various conceptual strands of the cyclical influence." Although there exists a positive association between the frequency of strikes and the level of economic activity in Australia, it is still not known what behavioural relations underlie this cyclical pattern. The present paper examines one behavioural model of strike activity, that of Aschenfelter and Johnson [1], and may be viewed as a first step in discriminating among a number of pro-cyclical strike explanations.

Aschenfelter and Johnson's analysis is a formalisation of some of A.M. Ross' [13] ideas on trade union behaviour. This analysis avoids the problems of bilateral monopoly by postulating that there are not just two but three parties involved in union-employer negotiations: the management, the union leadership and the rank and file.

The objectives of the union leadership are assumed to be, inter alia: the development and growth of the union and the personal, political survival of the leaders. Although these objectives are secured generally through satisfying the expectations of the union rank and file, the union leadership does more than merely represent the wishes of union members. The union leadership, compared with the rank and file, is better able to assess the maximum concession which can be received from management, whilst being aware of the desires and expectations of union members. When the rank and file desires and expects to obtain a wage increase in excess of that which management is willing to concede, the union leadership knows that it cannot come to terms with management without jeopardizing its own standing within the union. A strike, however, enables the union leadership to reconcile the expectations of the rank and file, which decline with the length of the strike, with the offers of managements thereby ensuring its own political survival.

On this broad basis, Aschenfelter and Johnson construct an optimizing model, in which the well-informed, profit-maximising firm weighs the effect on profits of strike costs against the lower wage bill that is likely to follow a strike. The implication is that the probability of a strike depends positively on the size of the wage increase acceptable to the rank and file before industrial action; positively on the management's assessment of the rate of decline of the acceptable wage increase under strike conditions; and negatively on the cost of a strike to the firm in the form of profits foregone.

(2) Aschenfelter and Johnson: Some Criticisms

In spite of its elegance, Bentley and Hughes argue that the Aschenfelter and Johnson model is incompatible with the Australian industrial relations framework. They give the following reasons:
(i) The existence of the arbitration system "shifts the responsibility for particular judgments from the shoulders of union leaders to the shoulders of judges" and further, allows the leaders to preserve their political standing by denouncing those judgments without resort to a strike.

(ii) "There is an important constraint (represented by the prominence of the judicial authorities and buttressed by the penal clauses) to the use of a strike as a direct weapon to secure changes" And hence,

(iii) Australian strikes "serve mainly as a protest against unsettled rights issues and as a token demonstration of labour's strength."

A number of counter-arguments may be advanced which suggest that the Aschenfelter and Johnson model may not be as irrelevant to the Australian industrial relations scene as Bentley and Hughes suggest. Nevertheless, it should be stressed from the outset that these counter-arguments are not intended to convince the reader of the a priori validity of the Aschenfelter and Johnson model in an Australian context. Rather, it is sufficient that they cast some doubt on the reasons given for the a priori rejection of that model. Testing the implications of the model against observed Australian behaviour should indicate whether that model is invalid or not.

The counter-arguments which follow take up Bentley and Hughes' arguments in order.

(i) If arbitration leads to judgments which consistently fall short of what is acceptable to the rank and file, it is unlikely that union leaders can retain their credibility and their political standing by merely denouncing those decisions. The rank and file will eventually want action. The increase in industrial action and settlements outside the arbitration system observed throughout the late 1960s and early 1970s may, in part, reflect this attitude.

(ii) The arbitration system may reduce strikes. But the important question is whether or not the system breaks the underlying behavioural relationships which lead to work stoppages. If one necessary condition for a strike over wages is, as in the Aschenfelter and Johnson model, that the wage increase initially acceptable to the union rank and file is greater than management is prepared to concede, and if arbitration succeeds in removing some of the difference between workers' expectations and management's offer, some strikes will be averted. This is because, after arbitration, such strikes would cost the firm more in terms of revenue foregone than it would gain by further reducing the wage increase acceptable to the rank and file. However, this does not alter the basic proposition that a strike will be more likely, ceteris paribus, the higher is the initial wage increase acceptable to the union rank and file.
The third argument, that institutionalised arbitration has changed the
pattern of Australian strike activity from strikes predominantly over wages and
other "interest" or "economic" issues to strikes predominantly over "rights" or
"non-economic" issues, appears to carry more weight. The Aschenfelter and
Johnson model focuses on disputes over wages. However, two points are worth
noting. First, the argument carries less weight now because of the dramatic
increase in strikes over wages as a proportion of total strikes. (This is
explainable in terms of the Aschenfelter and Johnson model). Secondly, it may
be argued that strikes over non-economic issues are more likely to occur when
economic interests are under attack. It is plausible that strikes, apparently
directed at non-economic grievances, may occur most frequently when economic
interests are threatened, when rank and file expectations are unlikely to be
satisfied by negotiation and when unions are economically in their most powerful
bargaining position. Hence, a model based mainly on economic considerations
may have a contribution to make to the explanation of strike activity which is
alleged to be non-economic in character.

Nevertheless, because the last point of Bentley and Hughes may have
some substance, our model of strike activity in Australia is divided, initially,
into two parts: one explaining strikes over wage issues, for which the
Aschenfelter and Johnson model forms the basis, and the other explaining strikes
over non-wage issues. The two are then combined to provide an estimating
equation for total strike activity in Australia.

Whilst accepting the general approach of Aschenfelter and Johnson to
strikes over wage issues, we have one strong criticism of their formal analysis
which is taken care of in our revised model. They implicitly assume a zero
expected change in the general price level. For example, it is obvious (from
their equations 1, 2 and 4) that the proportional increase in the negotiated
wage, which they consider, relates to a change in money wages. However, the
acceptable increase in wages prior to any strike is later made to depend upon
a moving average of previous changes in real wages without any reference to
expected changes in the price level. This would be valid only where price
inflation is expected to be zero. That the firm expects to sell its output
"at the same price into the indefinite future" (equation 4) points to the
same implicit assumption. This poses a question. Does a general expectation
of inflation invalidate or merely add to the conclusions derived from the model?
Over time workers' and managements' expectations concerning the future rate of
price inflation may diverge, and the direction and extent of the divergence may
impinge on the bargaining situation. In the Introduction, we argued intuitively
that workers are likely to overestimate, and managements are likely to under-
estimate future price rises and that this will worsen at high rates of inflation, consequently increasing strike activity. This result may be derived from our revised model in which expectations are incorporated.

(3) A Revised Model of Strikes over Wage Issues

We consider separately strikes over wage issues (characterized by $^\wedge$ in the following analysis) and strikes over non-wage issues (characterized by $^+$). The Aschenfelter and Johnson model forms the basis of the first, with which we start.

We define the negotiated money wage increase which is acceptable to a particular union's rank and file as

$$\hat{w} = \frac{\Delta w}{W_{-1}}$$  \hspace{1cm} (1)

where $W_{-1}$ is the previous wage rate, $\Delta w$ is the absolute increase in the negotiated wage which must be acceptable to the rank and file and $\hat{w}$ is thus in proportional terms. The reasoning of Aschenfelter and Johnson suggests that $\hat{w}$ should decrease as the length of the strike, $S^*$, increases.

We suppose that the decrease in $\hat{w}$ over the strike period takes the following form:

$$\hat{w} = \hat{w}_0 \frac{e^{-\lambda S^* + \delta}}{(1 + \delta)}; \quad \hat{w}_0 > 0 \text{ and } \delta > 0$$  \hspace{1cm} (2)

which may be represented diagrammatically as in FIG. 1.

![FIG. 1.](image)

We may regard $\hat{w}_0$ as the increase in wages acceptable to the union rank and file prior to any strike activity and $\frac{\delta \hat{w}_0}{1 + \delta}$ as the lowest wage increase they would accept even in the event of a very long strike.12
Further, we assume that the typical firm confronting this union is aware of the parameters of this relationship (2) and that it attempts to maximise profits. The typical firm's profit level in each period is given by

$$R = PQ - WN - K$$  \( (3) \)

where \( P \) is the price of the firm's product expected to prevail after the negotiations, \( Q \) is the level of the firm's output, \( W \) is the negotiated wage, \( N \) is the level of employment and \( K \) is the level of fixed production costs. \( P, Q \) and \( N \) are expected to continue at the same levels into the indefinite future.

The negotiated wage rate may be written from (1) and (2) as

$$W = \frac{\lambda}{\lambda + \delta} \left[ l + \frac{\lambda}{\lambda + \delta} \left( \frac{e^{-\lambda S^N}}{1 + \delta} \right) \right]$$  \( (4) \)

Let us suppose further that the firm expects to be able to raise its own product price, after renegotiating the wage rate, only in line with the general rise in the price level. The expected price of the firm's product may therefore be written as

$$P = P_{-1} (1 + \frac{\lambda}{\lambda + \delta})$$  \( (5) \)

where \( P_{-1} \) is the firm's previous price and \( \frac{\lambda}{\lambda + \delta} \) is the rate at which management expects the general price level to rise. Substituting (4) and (5) into (3) gives.

$$R = P_{-1} (1 + \frac{\lambda}{\lambda + \delta}) Q - \frac{\lambda}{\lambda + \delta} \left( \frac{e^{-\lambda S^N}}{1 + \delta} \right) N - K$$  \( (6) \)

The present value of the future profit stream, which we assume management tries to maximise, is

$$V = \int_0^\infty R e^{-rt} \, dt$$  \( (7) \)

where \( r \) is the firm's chosen rate of discount. Substituting (6) into (7), whilst recognizing that the firm earns no revenue and pays no wages while a strike is on, gives

$$V = \int_{S^N}^\infty \left[ P_{-1} (1 + \frac{\lambda}{\lambda + \delta}) Q - \frac{\lambda}{\lambda + \delta} \left( \frac{e^{-\lambda S^N}}{1 + \delta} \right) N \right] e^{-rt} \, dt$$

$$- \int_0^\infty K e^{-rt} \, dt$$  \( (8) \)

Upon integration (8) becomes

$$V = \left[ P_{-1} (1 + \frac{\lambda}{\lambda + \delta}) Q - \frac{\lambda}{\lambda + \delta} \left( \frac{e^{-\lambda S^N}}{1 + \delta} \right) N \right] \int_0^\infty e^{-rt} \, dt - \frac{K}{r}$$  \( (9) \)

which depends on \( S^N \), the length of the strike. The first-order condition for \( V \) to be a maximum is \( \frac{dV}{dS^N} = 0 \). Differentiating (9) with respect to \( S^N \), setting the derivative equal to zero and rearranging yields
\[ \lambda_r W_{-1} \stackrel{\Delta}{w}_0 \frac{e^{-\lambda S^*}}{1+\delta} N = P_{-1} (1+\theta_p) Q - W_{-1} (1+\delta \frac{e^{-\lambda S^*}}{1+\delta} \frac{w_0}{w_0}) N. \] (10)

This indicates that this typical firm will allow a strike over wages to continue until the rate at which the discounted future increase in the wage bill is reduced by the strike (the marginal benefit of the strike to the firm) equals the rate at which revenue is foregone at that phase of the strike. As Aschenfelter and Johnson say: "The firm that maximises V has the choice of agreeing to \( \stackrel{\Delta}{w}_0 \) and avoiding a strike or of rejecting \( \stackrel{\Delta}{w}_0 \) and incurring a strike which will result in a lower wage increase. In effect, the firm must weigh the effect on profits of strike costs against the ... lower wage costs which can be expected to accompany a strike."\(^{14}\) The second-order condition for \( V \) to be at a maximum, \( \frac{d^2V}{dS^2} < 0 \), is satisfied when \( W_{-1}, N, \stackrel{\Delta}{w}_0, \delta, \lambda, r > 0 \) which is true by assumption.\(^{15}\)

Equation (10) may be solved for \( S^* \)

\[ S^* = \frac{1}{\lambda} \ln \left[ \frac{W_{-1} N \stackrel{\Delta}{w}_0 (1+\frac{\lambda}{r})/(1+\delta)}{P_{-1} Q (1+\theta_p) - W_{-1} N (1+\delta \frac{\stackrel{\Delta}{w}_0}{1+\delta})} \right] \text{ for } S^* > 0 \] (11)

\[ = 0, \text{ elsewhere} \]

For a strike over wages to occur, \( S^* > 0 \), equation (11) requires that

\[ \frac{\lambda}{\stackrel{\Delta}{w}_0} > \frac{P_{-1} Q (1+\theta_p) - W_{-1} N \left[ 1+\frac{\lambda}{\delta(1+\delta)} \right]}{W_{-1} N} \cdot \frac{1+\delta \frac{\lambda}{r}}{1+\lambda \frac{\lambda}{r}} \]

\[ = 0, \text{ elsewhere} \]

Other things equal, this inequality is more likely to be satisfied and a strike over wages is more likely to occur:

(i) the greater is \( \stackrel{\Delta}{w}_0 \) i.e. the greater the increase in money wages initially acceptable to the union rank and file;

(ii) the smaller is \( \theta_p \) i.e. the slower the rate of price inflation expected by management.

(iii) the greater is \( \lambda \) i.e. the greater the rate at which the wage increase acceptable to the rank and file decreases under strike conditions;

(iv) the greater is \( \delta \) i.e. the larger is the lower bound to acceptable wage increases in relation to \( \stackrel{\Delta}{w}_0 \).

(v) the lower is \( r \) i.e. the lower is the firm's chosen rate of discount.

(vi) the lower is \( \frac{P_{-1} Q - W_{-1} N}{W_{-1} N} = \frac{R_{-1} + K}{W_{-1} N} \) i.e. the lower is the previous level of profits to the wage bill.
Generally, using points (i) to (vi) and writing \( \pi_{t-1} \) for the previous ratio of profits to the wage bill, we suppose that

\[
\text{pr}(S^*_t) = \mathcal{E} \left( W_{o,t}, \nu, p_m, t, \lambda_t, \delta_t, r_t, \pi_{t-1} \right)
\]

(13)

where \( \text{pr}(S^*_t) \) is the probability of a strike over wages in our typical firm in period \( t \).

The next task is to convert the conclusions regarding the typical firm's choice between industrial peace and industrial conflict over wages into an operational and testable form. This presents some difficulty since, of the explanatory variables in (13) only \( \pi_{t-1} \) is in a readily measurable form. A number of sub-hypotheses are needed to relate the other independent variables to some observable counterparts.

(4) \textbf{An Empirical Counterpart}

Let us start with an hypothesis concerning the formation of \( W_{o,t} \) the increase in money wages acceptable to the rank and file before strike activity, which is predicted to have a positive influence on \( \text{pr}(S^*_t) \). A reasonable assumption would appear to be that the rank and file initially look for a money wage increase to cover three things: first, the general increase in prices which they expect; secondly, the anticipated increase in labour productivity within the firm; plus, thirdly, a little extra which they hope to wrest from profits. We further assume that the anticipated increase in labour productivity in the firm may be represented by a constant and that the rank and file's assessment of their ability to wrest gains from profits is conditioned by the tightness of the labour market. Hence, we may write

\[
\hat{W}_{o,t} = \nu p_w + a_1 (v-u) + a_o
\]

(14)

where \( p_w \) is the rate at which the union rank and file expect the general price level to rise, \( v \) is the vacancy rate, \( u \) is the unemployment rate and \( a_1 \) and \( a_o \) are constants.

As already mentioned, \( \pi_{t-1} \), the previous ratio of profits to the wage bill, which should have a negative influence on the probability of a strike according to the analysis, is directly measurable. However, the sign of the effect of changes in \( \pi_{t-1} \) on \( \text{pr}(S^*_t) \) may not be unambiguous. Management is more likely to agree to union wage demands without a strike when profits have been high because the costs of a strike in terms of profit foregone are also high. Nevertheless, previously high profits may encourage the union to increase its initial demands which has a positive effect on \( \text{pr}(S^*_t) \) i.e. \( \pi_{t-1} \) is likely to
have a direct influence on $w_{o,t}$. Hence, it is not clear whether the net effect of an increase in previous profits is to increase, decrease or leave unchanged the probability of a strike over wages.

Although $\lambda$, $r$ and $\delta$ may vary from union to union or from firm to firm, it seems reasonable to assume that they will change only slowly over time. For example, $\lambda$, the rate at which the wage increase acceptable to the rank and file decreases under strike conditions, should depend upon the size of benefits generally paid out of strike funds, the contributions of other unions to the strike fund, etc.; all of which are institutionally determined. Hence, in our aggregative, time series analysis, we ought to be able to treat them as constants without doing great harm.

The arguments presented so far in II(4) combined with a simple, linear approximation to equation (13) suggest the following specification for $\text{pr}(S^*_t)$.

$$\text{pr}(S^*_t) = b_0 + b_1 \tilde{p}_{w,t} + b_2 \tilde{p}_{m,t} + b_3 (v-u)_t + b_4 \pi_{t-1}$$  \hspace{1cm} (15)

where we expect $b_0 > 0$, $b_1 > 0$, $b_2 < 0$, $b_3 > 0$ and $b_4 \leq 0$.

There still remains the problem of workers' and management's expectations of general price inflation, $\tilde{p}_w$ and $\tilde{p}_m$. The former is predicted to have a positive influence on $\text{pr}(S^*_t)$ and the latter a negative influence. The simplest way of treating expectations of inflation is as a learning process in which both workers' and management's expectations are weighted averages of the current and previously experienced rates of price inflation. That is, we assume

$$\tilde{p}_{w,t} = \gamma_0 \nu_1 \tilde{p}_{t-1}$$  \hspace{1cm} (16)

and

$$\tilde{p}_{m,t} = \gamma_0 \mu_1 \tilde{p}_{t-1}$$  \hspace{1cm} (17)

where $p_t$ is the rate of price inflation in period $t$.

Substituting (16) and (17) into (15) gives

$$\text{pr}(S^*_t) = b_0 + \gamma_0 (b_1 \nu_1 + b_2 \mu_1) p_{t-1} + b_3 (v-u)_t + b_4 \pi_{t-1}$$  \hspace{1cm} (18)

In general, $b_1 \nu_1 + b_2 \mu_1 \leq 0$. However, since $b_1$ is assumed to be positive and $b_2$ negative, the greater is $\nu_1 - \mu_1$, the more likely it is that $b_1 \nu_1 + b_2 \mu_1$ will be positive. That is, the more workers overestimate the future rate of inflation compared with management, the more likely it is that
current and previous rates of price change will have a positive influence on \( \text{pr} \left( S^*_t \right) \).

(5) **Strikes over Non-Wage Issues and Total Strike Activity**

To complete our model of strike behaviour, we have to consider determinants of strikes over issues other than wages in our typical firm. Following Bentley and Hughes [9], we assume that such strikes follow a cyclical pattern. The reasons for this are well set out in Bentley and Hughes [37]. Thus we write

\[
\text{pr} \left( S^*_t \right) = c_0 + c_1 (v-u)_t
\]

where \( \text{pr}(S^*_t) \) is the probability of a strike over broadly non-wage issues in our typical firm in period \( t \) and where \( c_0, c_1 > 0 \).

Since \( \text{pr}(S^*_t) \), the probability of a strike over any issue in our typical firm, is simply the sum of \( \text{pr}(S^*_t) \) and \( \text{pr}(S^+_t) \), we may combine equations (18) and (19) to give

\[
\text{pr}(S_t) = (b_0 + c_0) + \sum_{i=0}^{\infty} \left( b_1 \nu_1 + b_2 \nu_1 \right) p_{t-i} + (b_3 + c_1)(v-u)_t
\]

\[
+ b_4 \gamma_{t-1}
\]

Because \( \text{pr}(S_t) \) represents the probability of a strike in our typical firm in period \( t \), we must aggregate across all firms to derive an equation for total strike activity. Multiplying equation (20) by the number of firms in the economy, we arrive at an equation explaining the expected number of strikes in period \( t \).

However, certain modifications still seem advisable. A seasonal pattern exists in Australian strike activity. When the need for current income is high (prior to Christmas and over the Summer holidays) and when inclement weather may interrupt economic activity anyway (late Autumn and Winter) workers will be less likely to withdraw their labour. This suggests that, other things equal, strike activity will be higher in the third quarter of each year than in the other quarters. The problem of seasonality in the dependent variable may be overcome by the use of seasonal dummy variables in the estimating equation or by 'smoothing' the dependent variable itself prior to estimation. To conserve degrees of freedom, the latter course was adopted and the total number of recorded strikes was seasonally adjusted by means of a four point moving average.

In addition, the mere increase in population (of both workers and firms) over the sample period may have led to an increase in strikes. Hence, a
redefinition of the dependent variable from the number of strikes per period to
the number of strikes per ten thousand persons employed per period seems
advisable. Aggregation and modification along the suggested lines yield the
following equation for estimation.

\[ s_t = \alpha_0 + \alpha_1 \sum_{i=0}^{\infty} k_i p_{t-1} + \alpha_2 (v-u)_t + \alpha_3 \pi_{t-1} + \epsilon_{1t} \]  

(21)

where \( s \) is the seasonally adjusted number of strikes per ten thousand employed,
p is the percentage rate of change of retail prices, \( v \) is the seasonally
adjusted civilian vacancy rate, \( u \) is the seasonally adjusted civilian unemploy-
ment rate and \( \pi \) is the ratio of gross trading profits to the total wage and
salary bill. \( \epsilon_{1t} \) is a random error term assumed to possess a zero mean and
finite variance. The sign predictions are as follows:
\( \alpha_0 > 0, \alpha_1 k_1 \leq 0, \alpha_2 > 0 \) and \( \alpha_3 \leq 0 \), remembering that the more workers over-
estimate the future rate of inflation compared with management, the more likely
it is that \( \alpha_1 k_1 > 0 \).

III. MODELS OF WAGE AND PRICE BEHAVIOUR

In this section, we attempt to construct estimating equations for the
rate of change of money wage earnings and for the rate of change of prices to
complete our simple, three-equation model. In particular, we wish to allow for
the possible impact of strike activity on the rate of change of money wages.

(I) Wages and Trade Union Pushfulness: An Introduction

The failure of much previous research to find any significant impact of
trade union activity on wage inflation in Australia may be explained by the
inappropriate proxy variables used by many of the studies.

Three main variables have been used as surrogates for trade union
aggressiveness in Australian studies: the rate of change of the percentage of
the labour force unionised, \(^{16}\) the number of working days lost through strike
activity per time period\(^{17}\) and the number of union members involved in strikes
per time period.\(^{18}\) The percentage of the labour force unionised has been
dominated by time trends, so that its rate of change has shown little variability.
As a result, we might have expected it to be a poor surrogate for trade union
pushfulness. The number of working days lost through strikes appears to be
worse than useless as a proxy for trade union aggressiveness. It has two
dimensions, the number of strikes per time period and the average duration of
each strike. The first dimension, we argue, may be a good proxy for rank and
file pushfulness. But the average duration of each strike may vary inversely
with union strength. Weaker unions may be forced into a protracted strike in
order to reduce their wage demands. Indeed, the model of strike activity examined in Part II assumes that the wage increase acceptable to the union rank and file will decline as the duration of the strike increases. The two dimensions of the variable work in opposite directions, so that the net effect of the number of working days lost through strikes on wage inflation is indeterminate and may well be zero, even if union militancy does have an effect. The third surrogate, the number of union members involved in strikes per time period, seems to be the best used so far in Australia, both on theoretical grounds and in terms of performance.

However, we have chosen to use the number of strikes per ten thousand workers per time period as our measure of trade union pushfulness, for two reasons. First, because it has been used with some success in the U.S. as a measure of rank and file unrest. Secondly, because our model of strike activity suggests that it is theoretically a good surrogate for rank and file pushfulness. The strike model, as embodied in equations (1) to (12), suggests that a rise in the initial percentage wage increase acceptable to the union rank and file (pushfulness) increases the probability of a strike within the individual firm and also raises the percentage wage increase eventually negotiated. At the aggregate level, an increase in rank and file pushfulness in the form of increased initial wage demands manifests itself, ceteris paribus, in both an increased number of strikes and a rise in the percentage increase in negotiated wage rates. On this basis, the number of strikes per ten thousand workers per time period suggests itself as a reasonable surrogate for successful union pushfulness.

(2) The Wage Equation

We take as our starting point, the Lipsey [9] interpretation of the Phillips Curve

\[ w = f_1 (v-u) \]  

(22)

The rate of change of money wage earnings \( (w) \) is an increasing function of excess demand in the labour market, approximated by the vacancy rate \( (v) \) less the unemployment rate \( (u) \). This approach may be modified in two ways. First, following Phelps [12] and Mortensen [11] we allow for the possibility of firms expecting a general increase or decrease in the wage levels of other firms in their labour market. According to this view, the firm attempts to control its wage relative to the expected market wage. Thus, when it wishes to adjust its own labour force, the firm will change its money wage offer at a rate equal to the general rate of wage inflation plus the rate by which it believes it needs
to alter its relative wage to effect the desired adjustment in its labour force. Thus, if there is excess demand in the labour market, each firm will try to attract labour by raising its wage relative to the expected market wage, thereby increasing wage inflation above the expected rate. We may write this formally as

\[ w = \hat{w}_m + f_1 (v-u) \]  

(23)

where \( \hat{w}_m \) is the rate of wage inflation expected by management.

Secondly, following the suggestion of Hines [6], we rewrite the wage adjustment equation as

\[ w = \hat{w}_m + f_2 (v-u | X) \]  

(24)

where \( X \) is a vector of exogenous variables which constitute shift parameters of the labour supply curve. Equation (24) indicates that the rate of unanticipated wage change is a function of proportional excess demand in the labour market given the elements of \( X \). In this specification of the adjustment equation, which includes the elements of \( X \), the excess demand term captures the adjustment of wages to their 'desired' or 'equilibrium' levels as of given supply relationships. This specification implies that variables such as trade union pushfulness, which determine the rate of shift of the labour supply curve need not be 'intruders' in the wage equation as so often stated.

In fact, the approach adopted in (24) covers a wide variety of situations. At one extreme, it comprehends the straightforward neo-classical model when the coefficients attaching to the variables in \( X \) are all zero. Equations (24) and (23) would then be strictly comparable. Union aggressiveness shifts the labour supply curve and has all of its influence on wage inflation through changes in the excess demand for labour. However, this neoclassical approach is meaningful only when labour supply is a strictly increasing function of the (real) wage rate. If the labour supply curve is neo-Keynesian and has a large horizontal section, representing some negotiated minimum money wage (say, award wage) rate, this approach is meaningless. Two simple diagrams will illustrate this.

LABOUR MARKET ADJUSTMENT \((\hat{w}_m = 0)\)

**FIG. 2 Neo-Classical**

**FIG. 3 Neo-Keynesian**
If union action results in a shift to the left of the labour supply curve in the neo-classical model (FIG. 2), excess demand at the wage rate $W_1$ will increase from $QR$ to $PR$. There will be an increased upward pressure on the wage rate, and it is reasonable to suppose that money wages will rise more rapidly than if the shift had not occurred. With the strictly rising labour supply curve, union aggressiveness would be accommodated in the excess demand term and equation (23) would be appropriate for the adjustment process. However this is not the case for FIG. 3.

In FIG. 3, the horizontal portion of the labour supply curve may be taken to represent a 'minimum' negotiated wage rate, say the award wage rate. At $W_2$ some excess demand in the labour market, $ST$, would still exist. Employers would bid the wage above the minimum to $W_3$, say by an increase in over-award payments - wage drift. This would be an adjustment of wages in response to excess demand for given labour supply and demand curves. Let us further suppose that trade union leaders are prepared to take industrial action, in response to increased pressure from the rank and file, culminating in an increase in the negotiated minimum (award) wage rate. The circumstances under which this is likely to occur have been covered in the section on the strike equation. If, as a result of rank and file pushfulness, the negotiated minimum (award) wage rate rises from $W_2$ to $W_4$, the wage rate will rise from $W_3$ to $W_4$. Note however, that it is not meaningful to talk of this adjustment arising from excess demand at $W_3$. With the new supply curve, $N^S_4$, excess demand at $W_3$ is meaningless, at least in any empirical sense. It is reasonable to speak only of further adjustment of the wage rate to excess demand, should such arise given the new labour supply curve. In this scheme of things, a parameter which shifts the labour supply curve is not an "intruder" in the wage equation. It is quite reasonable to divide upward pressures on wages, in an economy which is heavily unionised into factors which, for any given expected rate of wage change, determine the rate at which the labour supply curve is shifted upwards and excess demand which provides additional upward pressure for a given labour supply curve.

Because equation (24) covers the wide range of possibilities indicated - from neo-classical, when the coefficients attached to the variables in $X$ are all zero, to neo-Keynesian, when they are not - it is retained as the fundamental wage equation.

To convert equation (24) into a testable form, we need an expression for $\dot{w}_m$, the expected rate of wage inflation. It is hypothesised that management expect real wages to increase at the same rate as output per head. The operations of the Arbitration System have reinforced this expectation. Thus, we
may write
\[ \hat{\omega}_m = \hat{p}_m + \hat{q}_m \]  \hspace{1cm} (25)

where \( \hat{p}_m \) is the rate of change of retail prices, and \( \hat{q}_m \) is the rate of increase of output per head, expected by management. Substituting (25) into (24)
\[ w = \hat{p}_m + \hat{q}_m + f_2 (v-u|X) \]  \hspace{1cm} (26)

Assuming that expected rates of change may be approximated by a weighted average of current and previous rates of change, and considering a linear form, with the total number of strikes, \( s \), as the only shift parameter operating on labour supply provides our wage equation for estimation purposes.
\[ w_t = \beta_1 \frac{\hat{p}_m - \hat{p}_0}{\hat{p}_0} \sigma_1 p_{t-1} + \beta_2 \frac{\hat{q}_m - \hat{q}_0}{\hat{q}_0} \theta_1 a_{t-1} + \beta_3 (v-u)_t + \beta_4 s_t + \epsilon_{2t} \]  \hspace{1cm} (27)

where \( \frac{\hat{p}_m - \hat{p}_0}{\hat{p}_0} \sigma_1 = \frac{\hat{q}_m - \hat{q}_0}{\hat{q}_0} \theta_1 = 1 \). The following sub hypotheses should be noted:
\( \beta_3 > 0 \) and \( \beta_4 > 0 \). It is also possible that \( \beta_1 \) and \( \beta_2 \) may be less than unity even if the 'natural' unemployment hypothesis holds. This is because, in our three equation model, the expected rate of change of prices influences the rate of change of money wages both directly, through the wage equation, and indirectly, through the strike equation and the impact of strikes on the rate of change of money wages.

(3) \textbf{The Price Equation}

The derivation of the price equation follows Lipsey and Parkin [10]. Although the price-theoretic content is limited, this approach is adopted for its simplicity and for its performance in previous empirical studies. Starting with an identity.
\[ P = W \cdot N + M.T. + C.D. + \rho \]  \hspace{1cm} (28)

where \( P \) is the market price per unit of final output, \( W \) is the wage rate per unit of labour, \( N \) is the quantity of labour used per unit of output, \( M \) is the price per unit of imported materials, \( T \) is the quantity of imports per unit of output, \( C \) is the price per unit of 'other' inputs, \( D \) is the quantity of 'other' inputs per unit of output and \( \rho \) is profit per unit of output. Lipsey and Parkin give the identity some theoretical content by making the following assumptions:

(i) the quantity of imports per unit of output \( (T) \) is constant
(ii) 'other' costs \( (CD) \) are a constant fraction of labour and import costs
(iii) firms base their pricing decisions on the expected values of \( W, N \) and \( M \)
(iv) the expected share of wages and imports in final price are constant
(v) firms aim for a constant proportionate markup.
\[ p = \gamma_1 \hat{w}_m + \gamma_2 \hat{m}_m + \gamma_3 \hat{q}_m \]  \hspace{1cm} (29)
is then established as the price equation, where \( \hat{\gamma}_m \) = the expected proportional rate of change of import prices. We may relax assumption (v) by assuming that the proportionate markup varies with the state of excess demand in the product market (2), in which case

\[
\rho = \gamma_1 \hat{\gamma}_m + \gamma_2 \hat{\gamma}_m + \gamma_3 \hat{\gamma}_m + \gamma_4 z
\]

is an approximation. Again assuming expected rates of change to be conditioned by current and previous rates of change yields the following estimating equation.

\[
p_t = \gamma_1 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \gamma_2 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \gamma_3 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \gamma_4 z_t + \epsilon_{3t}
\]

where \( \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} = \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m \) and where it is predicted that \( \gamma_1, \gamma_2, \gamma_4 > 0 \) and \( \gamma_3 < 0 \).

### IV  EMPIRICAL FINDINGS

The model to be estimated comprised the following three equations:

\[
s_t = \alpha_0 + \alpha_1 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \alpha_2 (v-u)_t + \alpha_3 \pi_{t-1} + \epsilon_{1t}
\]

\[
w_t = \beta_1 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \beta_2 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \beta_3 (v-u)_t + \beta_4 s_t + \epsilon_{2t}
\]

\[
p_t = \gamma_1 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \gamma_2 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \gamma_3 \frac{\hat{\gamma}_m}{\hat{\gamma}_0} \hat{\gamma}_m t_{t-1} + \gamma_4 z_t + \epsilon_{3t}
\]

All three equations are overidentified, and the model was estimated using both two-stage least squares (2SLS) and three-stage least squares (3SLS) on Australian quarterly data. For estimation purposes the following definitions were adhered to:

- \( s = \) number of strikes per ten thousand civilian employed (s.a.)
- \( p = \) annual percentage rate of change of the consumer price index.
- \( w = \) annual percentage rate of change of average weekly earnings
- \( m = \) annual percentage rate of change of import prices
- \( q = \) annual percentage rate of change of gross national non-farm product per civilian employee
- \( v = \) registered vacancies (s.a.)/[total civilian employed (s.a.) plus registered unemployed (s.a.)]
- \( u = \) registered unemployed (s.a.)/[total civilian employed (s.a.) plus registered unemployed (s.a.)]
- \( \pi = \) gross operating surplus of companies (s.a.)/wage and salary bill (s.a.)
Excess demand in the product market (2) was approximated to by \((v-u)\), excess demand in the labour market, in spite of the well-known problems involved. Further, time \((t)\) was used as an additional explanatory variable in the strike equation to guage whether or not there has been an increase in trade union militancy in the period. After rates of change were calculated and seasonal adjustments were made, the sample period become 1960 (first quarter) to 1972 (last quarter).

After trying a number of different lag structures, our preferred equation estimates are those set down in Tables 1 and 2.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>2SLS ESTIMATES</th>
<th>1960(1) to 1972(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I(A)</td>
<td>( s_t = 0.01 + 0.04 p_t + 2.40 \pi_{t-1} + 0.009 t )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.05) (3.01)** (2.69)** (5.05)**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( R^2 = 0.75, \quad d = 1.15^+ )</td>
<td></td>
</tr>
<tr>
<td>I(B)</td>
<td>( w_t = 0.23 p_t + 0.24 q_t + 0.92(v-u)_t + 6.24 s_t )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.98) (2.69)** (2.46)** (6.50)**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( R^2 = 0.72, \quad d = 1.98^{++} )</td>
<td></td>
</tr>
<tr>
<td>L(C)</td>
<td>( p_t = 0.27 w_t + 0.18 w_{t-1} - 0.02 q_t + 0.12 q_{t-1} + 0.26 m_{t-1} + 0.38 (v-u)_t )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.68)* (1.10) (0.22) (1.22) (2.77)** (2.09)*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( R^2 = 0.66, \quad d = 1.17^+ )</td>
<td></td>
</tr>
</tbody>
</table>

Notes

- t- ratios are in parentheses
- * indicates coefficient is significant at 5% level
- ** indicates coefficient is significant at 1% level
- d indicates the Durbin-Watson statistic \( \frac{2}{4} \)
- ++ reject hypothesis of serial correlation in the residuals at the 5% level of significance
- + test for serial correlation indeterminate.
Before these results are generally discussed, three important things should be noted. First, the excess demand for labour term \((v-u)_t\) has been omitted from the strike equation. This is because, when it was included, its coefficient took up a significant, negative value without adding anything to \(R^2\). Step-wise regression estimates illustrating this phenomenon are presented in Table 3. Estimates are given for the strike equation only; the structure of the other two equations remained the same as for the results presented in Tables 1 and 2. The most likely explanation for this perverse result is that it stems from the high collinearity between \(p_t\) and \((v-u)_t\). The simplest way out of the dilemma was to drop \((v-u)_t\) from the strike equation.
### TABLE 3 STRIKE EQUATION ESTIMATES

#### 2SLS Estimates

<table>
<thead>
<tr>
<th>Dep. Var.</th>
<th>p_t</th>
<th>(v-u)_t</th>
<th>π_t</th>
<th>t</th>
<th>const.</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>s_t</td>
<td>.10</td>
<td>(7.82)</td>
<td></td>
<td></td>
<td>.72</td>
<td>.49</td>
</tr>
<tr>
<td>s_t</td>
<td>.12</td>
<td>-.07</td>
<td></td>
<td></td>
<td>.61</td>
<td>.48</td>
</tr>
<tr>
<td>s_t</td>
<td>(7.23)</td>
<td>(1.67)</td>
<td></td>
<td></td>
<td>(7.66)</td>
<td></td>
</tr>
<tr>
<td>s_t</td>
<td>.10</td>
<td>2.29</td>
<td></td>
<td></td>
<td>.10</td>
<td>.52</td>
</tr>
<tr>
<td>s_t</td>
<td>(8.16)</td>
<td>(1.85)</td>
<td></td>
<td></td>
<td>(.31)</td>
<td></td>
</tr>
<tr>
<td>s_t</td>
<td>.04</td>
<td>2.40</td>
<td>.009</td>
<td></td>
<td>.01</td>
<td>.75</td>
</tr>
<tr>
<td>s_t</td>
<td>(3.01)</td>
<td>(2.69)</td>
<td>(5.05)</td>
<td></td>
<td>(.05)</td>
<td></td>
</tr>
</tbody>
</table>

#### 3SLS Estimates

<table>
<thead>
<tr>
<th>Dep. Var.</th>
<th>p_t</th>
<th>(v-u)_t</th>
<th>π_t</th>
<th>t</th>
<th>const.</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>s_t</td>
<td>.12</td>
<td>(9.94)</td>
<td></td>
<td></td>
<td>.65</td>
<td>.42</td>
</tr>
<tr>
<td>s_t</td>
<td>.14</td>
<td>-.10</td>
<td></td>
<td></td>
<td>.49</td>
<td>.37</td>
</tr>
<tr>
<td>s_t</td>
<td>(10.89)</td>
<td>(3.06)</td>
<td></td>
<td></td>
<td>(7.96)</td>
<td></td>
</tr>
<tr>
<td>s_t</td>
<td>.12</td>
<td>.32</td>
<td></td>
<td></td>
<td>.58</td>
<td>.45</td>
</tr>
<tr>
<td>s_t</td>
<td>(9.60)</td>
<td>(.27)</td>
<td></td>
<td></td>
<td>(1.82)</td>
<td></td>
</tr>
<tr>
<td>s_t</td>
<td>.06</td>
<td>1.67</td>
<td>.008</td>
<td></td>
<td>.20</td>
<td>.73</td>
</tr>
<tr>
<td>s_t</td>
<td>(3.90)</td>
<td>(1.90)</td>
<td>(4.54)</td>
<td></td>
<td>(.84)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

Equations for p_t and w_t incorporated the same explanatory variables as those shown in equations I(B) and 2(B) and I(C) and 2(C) of Tables 1 and 2.

The second thing to notice about the estimates set out in Tables 1 and 2 is that, except for the price equation, additional lagged values of the explanatory variables did little or nothing to improve the goodness of fit. This can be explained in part by the fact that annual rates of change of p, w, m, and q were used rather than quarter to quarter changes.
Another slightly disturbing feature of the results is the differences between the 2SLS and 3SLS estimated coefficients (Tables 1 and 2). Such differences are, however, within the bounds of estimating errors. Further, these differences do not alter substantially the main qualitative conclusions to be drawn from significance tests on the coefficients. However, they do indicate that the estimated equations should not be relied upon for forecasting purposes.

Let us first examine those conclusions which may be drawn from the strike equation (Tables 1 and 2). Two major economic variables emerge as having a strong, positive impact on strike activity. These are the rate of change of the consumer price index and the ratio of gross operating surplus of companies to the wage and salary bill. Coefficients on both variables are significantly greater than zero in both 2SLS and 3SLS estimates. Furthermore, approximately 42-49% of the variation in \( s_t \) can be explained by variations in \( p_t \) alone (see Table 3). A rise in the annual rate of price inflation of one percentage point would increase the number of strikes per million employed per quarter, on average, by 4, according to the 2SLS estimate, or by 6, according to the 3SLS estimate. A rise of .61 in the ratio of gross operating surplus to the wage bill would increase the number of strikes per million employed by 2.40, according to the 2SLS estimate, and 1.67, according to the 3SLS estimate. Further, both sets of estimates indicate that there has been a secular increase in strike activity, unaccounted for by changes in price inflation or income distribution. Other things equal, the unexplained increase per million employed has been just under one strike per quarter.

Turning to the wage equation (Tables 1 and 2), both sets of estimates indicate that strike activity has a strong, positive impact upon the rate of change of money wage earnings. In both cases, the coefficient is significantly greater than zero at the 1% level of significance. An increase of ten strikes per million employed per quarter would on average raise the annual rate of wage change by approximately .6 of a percentage point according to the 2SLS estimate or approximately .45 of a percentage point according to the 3SLS estimate.

The main ambiguities in the study arise with regard to the rest of the variables in the wage equation. According to the 2SLS estimate, the direct impact of the rate of price change on the rate of wage change is small (−.23) and not significantly greater than zero. Whereas, according to the 3SLS estimate, it is larger (−.65) and significantly greater than zero. On the other hand, the impact of (v-u) is significant in the 2SLS estimate and not quite significant in the 3SLS estimate. This paradox may again be explained in terms
of the collinearity between \( p_t \) and \( (v-u)_t \).

From this study, it emerges that strike activity has a very important role to play in transforming price inflation into wage inflation. A one percentage point increase in the annual rate of change of the consumer price index leads indirectly, through an increase in strike activity, to an increase of approximately \( 0.25 \) of a percentage point in the annual rate of change of wage earnings (viz. \( 0.04 \times 6.24 = 0.25 \), according to the 2SLS estimates and \( 0.06 \times 4.53 = 0.27 \), according to the 3SLS estimates). In the case of the 3SLS estimates, this leads to a combined effect of price inflation on wage inflation of \( 0.92 \) \( = \beta_1 + \beta_4 \gamma_1 = 0.65 + (0.06)(4.53) \). This is not significantly less than the unity of the 'natural' unemployment hypothesis. \(^{27}\)

It was not the original intention of this study to pass judgment on the 'demand-pull versus cost-push' controversy. However, there appears to be some evidence for both points of view here. The significance of the excess demand term in the price equation and the significance (or near significance in the case of 3SLS) of the same term in the wage equation give strong support to the demand-pull hypothesis. Nevertheless, there is some support also for a secular cost-push hypothesis. As mentioned previously, there has been an unexplained trend increase in strike activity which, combined with the impact of strike activity on the rate of change of wage earnings, would have led, ceteris paribus, to an increase in the annual rate of wage inflation over the sample period of between 2 and 3 percentage points (\( 0.09 \times 52 \times 6.24 = 2.8 \) from the 2SLS estimates and \( 0.008 \times 52 \times 4.53 = 2 \) from the 3SLS estimates). There is also some evidence to suggest that changes in income distribution may indirectly affect the rate of wage inflation. A change in income distribution in favour of profits will provoke an increase in strike activity and a consequent rise in the rate of change of wage earnings. \(^{28}\)

V GENERAL CONCLUSIONS

Any conclusions drawn at this stage must be tentative because of the statistical problems mentioned earlier. However, 2SLS and 3SLS estimates provided in this study indicate strongly that strike activity is both a cause and a consequence of inflation. Increases in the rate of price inflation stimulate strike activity which, in turn, raises the rate of change of wage earnings. This observation is consistent with a model in which strikes reconcile divergences between rank and file expectations and managements' wage offers; in particular divergences between rank and file expectations, and managements' expectations, of the future rate of price change. The evidence produced
here is also consistent with the view that strike activity rises in response to a redistribution of income favouring profits at the expense of wages and salaries. In addition to these two economic explanations of changes in strike activity, there appears to have been a steady, though not rapid, unexplained increase in strikes over the sample period.

A. J. PHIPPS.
APPENDIX I

An Alternative Strike Equation

Another set of results was obtained using seasonal dummy variables instead of seasonally adjusting the strike variable. In the following results which are presented without comment, $s_t$ is the unadjusted series and $d_j$, $d_2$ and $d_3$ are seasonal dummy variables pertaining to the second, third and fourth quarters respectively.

<table>
<thead>
<tr>
<th>2 SLS ESTIMATES</th>
<th>1960(1) to 1972(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3(A)</strong></td>
<td>$s_t = -0.33 + 0.03 p_t + 3.56 \pi_{t-1} + 0.01 t + 0.03 d_{1t} + 0.20 d_{2t} - 0.05 d_{3t}$</td>
</tr>
<tr>
<td></td>
<td>(0.99) (1.47) (2.94)** (4.19)** (3.07)** (0.85)</td>
</tr>
<tr>
<td></td>
<td>$R^2 = 0.67$; $d = 2.03$</td>
</tr>
</tbody>
</table>

| **3(B)** | $w_t = 0.33 p_t + 0.28 q_t + 0.73(v-u)_t + 3.68 s_t + 2.02 s_{t-1}$ |
| | (1.32) (2.84)** (1.85)* (2.88)** (1.42) |
| | $R^2 = 0.68$; $d = 2.38$ |

| **3(C)** | $p_t = 0.17 w_t + 0.28 w_{t-1} + 0.09 q_t + 0.09 q_{t-1} + 0.25 m_t + 0.37(v-u)_t$ |
| | (1.00) (1.59) (1.13) (0.98) (2.74)** (2.09)* |
| | $R^2 = 0.67$; $d = 1.67$ |

<table>
<thead>
<tr>
<th>3 SLS ESTIMATES</th>
<th>1960(1) to 1972(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4(A)</strong></td>
<td>$s_t = -0.25 + 0.03 p_t + 3.21 \pi_{t-1} + 0.01 t + 0.03 d_{1t} + 0.19 d_{2t} - 0.05 d_{3t}$</td>
</tr>
<tr>
<td></td>
<td>(0.73) (1.61) (2.67)** (4.31)<strong>(0.42) (3.05)</strong> (0.83)</td>
</tr>
<tr>
<td></td>
<td>$R^2 = 0.67$; $d = 2.03$</td>
</tr>
</tbody>
</table>

| **4(B)** | $w_t = 0.66 p_t + 0.23 q_t + 0.35(v-u)_t + 2.28 s_t + 2.16 s_{t-1}$ |
| | (2.83)** (2.37)* (1.65)* (1.98)* (1.65)* |
| | $R^2 = 0.65$; $d = 2.29$ |

| **4(C)** | $p_t = 0.23 w_t + 0.26 w_{t-1} - 0.02 q_t + 0.04 q_{t-1} + 0.17 m_t + 0.39(v-u)_t$ |
| | (1.44) (1.64)* (0.23) (0.54) (2.11)* (2.17)* |
| | $R^2 = 0.66$; $d = 1.67$ |
APPENDIX II

Data and their Sources

The following definitions were used to obtain the series on which the regressions were run. The source of a particular series is given in parentheses, D. of L. stands for Department of Labour, B. of C. and S. for the Bureau of Census and Statistics and R. B. of A. for the Reserve Bank of Australia.

s = number of strikes (D. of L.) per ten thousand civilians employed (D. of L.) adjusted by means of a four point moving average (=s.a.)

p = annual percentage rate of change of the consumer price index (B. of C. and S.)

w = annual percentage rate of change of average weekly earnings (B. of C. and S.)

m = annual percentage rate of change of the import price index (R. B. of A.)

q = annual percentage rate of change of gross national non-farm product (B. of C. and S.) per civilian employee (B. of C. and S.)

v = registered vacancies (D. of L.) s.a./ [total civilian employees (B. of C. and S.) s.a. plus registered unemployed D. of L.) s.a.]

u = registered unemployed (D. of L.) s.a./ [total civilian employees (B. of C. and S.) s.a. plus registered unemployed s.a.]

π = gross operating surplus of companies B. of C. and S.) s.a./ wage and salary bill (B. of C. and S.).

All annual rates of change were calculated in a manner similar to

\[ p_t = \frac{P_{t+2} - P_{t-2}}{P_{t-2}} \times \frac{100}{1} \]

where P is the consumer price index.

And all four point moving averages in a manner such as

\[ V_t \text{s.a.} = \frac{1}{2} \left[ \frac{1}{4}(V_{t-2} + V_{t-1} + V_t + V_{t+1}) + \frac{1}{4} (V_{t-1} + V_t + V_{t+1} + V_{t+2}) \right] \]

where V is the number of registered vacancies.
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FOOTNOTES

1. The Author wishes to thank Mrs Janet Rybak and T. P. Truong for computing assistance and Viv Hall, Warren Hogan, Evan Jones, Ian Sharpe and Colin Simkin for Helpful suggestions at various stages in the preparation of this paper.

2. That is, has there been an increase in trade union militancy over and above that occasioned by changes in any objective factors which may be isolated as explaining strike activity?

3. For the Australian data used in this study, the correlation coefficient between the total number of strikes per million employed and the rate of change of retail prices is 0.69 and that between strikes and the rate of change of wage earnings is 0.81.

4. Bentley and Hughes [3]

5. It is implicitly assumed that the firm can precipitate a strike by a wage offer below, and terminate a strike by a wage offer in accord with, rank and file expectations at the appropriate point of time.

6, 7 and 8 Bentley and Hughes [3], pp. 152-153

9. Aschenfelter and Johnson [1], pp. 37-38

10. Aschenfelter and Johnson [1], p. 41

11. Aschenfelter and Johnson [1], p. 38

12. The lower bound to the acceptable wage increase is assumed to be a positive fraction of the initially acceptable wage increase because this is intuitively more plausible than Aschenfelter and Johnson's constant lower bound. It also avoids the implausible implication of Aschenfelter and Johnson's formulations that the wage rate eventually negotiated is completely independent of the wage increase acceptable to the union rank and file prior to a strike.

13. For the sake of simplicity, we are assuming that our typical firm faces only the one union.

14. Aschenfelter and Johnson [1], p. 38

15. \[ \frac{d^2V}{dS^2} = -r \frac{dV}{dS^*} - \lambda (1 + \frac{\lambda}{T})e^{-\lambda + r})S^* W_{-1} N \frac{w}{(1+\delta)} \] which is negative under the stated conditions.


17. See, for example, Johnson et al [7].

18. See, for example, Kerry Schott [14]

19. Aschenfelter, Johnson and Pencavel [2].
20. We have already established that $\text{pr}(S^*)$ increases with $\hat{w}_o$. We here wish to establish that

$$\hat{w}_o \left( e^{-\lambda S^* / (1 + \delta)} \right)$$

the wage increase negotiated after the end of the strike, increases with $\hat{w}_o$.

Now

$$E = \frac{3}{2} \left[ \hat{w}_o \left( e^{-\lambda S^* / (1 + \delta)} \right) \right] = (e^{-\lambda S^* / (1 + \delta)} - \lambda \hat{w}_o e^{-\lambda S^* / \hat{w}_o}) / (1 + \delta)$$

But from equation (11)

$$\frac{\partial S^*}{\partial \hat{w}_o} = \frac{1}{\lambda \hat{w}_o} + \frac{W_{-1} N \delta / (1 + \delta)}{\lambda (K_1 + K_2 \hat{w}_o)}$$

where

$$K_1 = P_{-1} (1 + \frac{\lambda}{r} m) Q - W_{-1} N$$

$$K_2 = - W_{-1} N \delta / (1 + \delta)$$

Substituting $\frac{\partial S^*}{\partial \hat{w}_o}$ into $E$ yields

$$E = \frac{\delta}{1 + \delta} \left[ 1 - \frac{\hat{w}_o e^{-\lambda S^* / \hat{w}_o} W_{-1} N}{(1 + \delta)(K_1 + K_2 \hat{w}_o)} \right] = \frac{\delta}{1 + \delta} \cdot \frac{\lambda / r}{1 + \lambda / r}$$

It can be seen that $E > 0$ if $\delta > 0$ and $\lambda / r > 0$, which are true by assumption.

21. Clearly, this is how David Laidler [8] thinks it ought to operate. He makes the following comment on Hines' union variable, the rate of change of the percentage of the labour force unionised:

"However, he (Hines) failed to explain why this aggressiveness did not operate through shifts in the supply curve of labour and hence have its influence taken account of, along with the many other factors that presumably influence the excess demand for labour, in the unemployment rate." (Laidler [8], p.95)

22. A fuller description of the data and their sources is to be found in Appendix II.

23. s.a. stands for seasonally adjusted.

24. The usefulness of the Durbin-Watson d-statistic and $R^2$ in 2 and 3SLS is questionable.

25. At least in the sense that 95% confidence intervals for each coefficient derived from 2SLS and 3SLS overlap.

26. Remember, $S$ was defined as strikes per ten thousand employed.
27. The asymptotic variance of the estimator \( L = \beta_1 + \beta_4 \gamma_1 \), is derived by inserting 3SLS estimated values into \( J^T SJ \) where \( J = \frac{\partial Q}{\partial [\beta_1 \beta_4 \gamma_1]} \) and \( S \) is the covariance matrix of \( [\beta_1 \beta_4 \gamma_1] \). See Goldberger, Nager and Odeh [4].

28. Though the author is of the firm opinion that a redistribution of income favouring profits is most likely to occur with an unanticipated increase in the rate of change of prices. In this case, changes in income distribution are not an independent source of inflation.
REFERENCES


