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STRIKE ACTIVITY AND WAGE DETERMINATION
UNDER RAPID INFLATION:
A QUANTITATIVE STUDY OF THE CHILEAN CASE

by

Mario I. Blejer

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STRIKE ACTIVITY AND WAGE DETERMINATION UNDER RAPID INFLATION:
A QUANTITATIVE STUDY OF THE CHILEAN CASE (1953-1973)*

I. INTRODUCTION

A relatively large number of quantitative studies have examined the conditions under which strikes, labor stoppages, and other types of labor unrest are more likely to occur. The large majority of those studies, however, have analyzed the experience of highly industrialized and developed countries. The incidence of strike activity in the United States has been carefully studied, among others by Aschenfelter and Johnson (1969), Skéels (1971), and Snyder (1977), while the British experience is extensively covered by the studies of Pencavel (1970), Sapsford (1975) and Shorey (1977).^{1/}

Since those countries have, in general, enjoyed relative price stability during the periods analyzed, it appears that the influence of inflationary factors in the bargaining process has been of less concern, and therefore the feedbacks and interrelationships between strike activity and price and wage determination have been only seldom explicitly considered. Thus, most of the studies on strike incidence have taken wages and prices as exogenous explanatory variables while many studies on wage

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^{1/} Other well-known studies include those by Vanderkamp (1970) and Walsh (1975) on Canada and Howells (1972) on New Zealand. A concise review of the major studies is presented by Stern (1978).

formation have used different measures of labor unrest as independent variables in the explanation of wage changes.^{1/}

In this paper we study the experience of Chile until 1973, a semi-industrialized, high-inflation country where it is conceivable that labor unrest has been particularly influenced by the inflationary environment within which the collective bargaining has to take place. Labor unrest certainly affects, and is itself affected by the process of wage inflation and, therefore, the existence of simultaneity between the incidence of strikes and the wage-formation process cannot be ignored in this context. For this reason we consider here a simple model which allows for the existence of feedbacks between strike activity and wage inflation and that is useful for the purpose of isolating and quantifying the effects of the main economic variables affecting the joint determination of strikes and wages.

The theoretical foundations of most of the studies on strikes at the macro level is the bargaining model developed by Aschenfelter and Johnson which considers the elements underlying the behavior of firms and trade unions.^{2/} A common criticism on the quantitative strike model is that while most of those models focus on wage disputes and other economic conflicts, many of the labor stoppages may be motivated by non-economic

^{1/} See, for example, Knight (1972), Hines (1964), Holt (1970), and Johnston and Timbrell (1973). An exception is the recent paper by Phillips (1977) who has studied the Australian case estimating a simultaneous equation model of strike activity, wage changes and price inflation.

^{2/} An analysis of the methodological issues related to the empirical studies on strikes is presented by Stern (1978).

issues. That criticism may be more serious when studying the experience of less developed countries since in those countries labor unrest and trade-union militancy are considered to have high political overtones.^{1/} However, as pointed out by Phillips (1970, page 300), strikes over allegedly non-economic issues are more likely to occur when economic interests appear to be threatened or are actually under attack. Therefore economic considerations may be an important element in explaining also those strikes which seem to be unrelated to economic conditions. Moreover, in our specific case, Chile, it is apparent that the overwhelming majority of strikes were indeed motivated by explicit and specific economic grievances. For example, Pizzaro (1978) has shown that during the period 1961-1970 about 75% of the labor disputes were directly caused by explicit economic demands, the majority of which were related to wage issues. We will, therefore, proceed to assume that also "non-economic" strikes are sensitive to economic variables similar to those which affect the other labor disputes.

It should be pointed out that during the period studied here strikes held in accordance with the negotiation and conciliation requirements were considered totally legal in Chile; workers involved in strikes could

^{1/} The causes and effects of strikes in developing countries appear to be a topic which has attracted very little attention from economists, particularly at the quantitative level. The special aspects of labor militancy in LDC's have been considered mainly in political and sociological contexts. For a discussion on the subject see Waterman (1976) and the comments to his article. See also Alexander (1962).

not be dismissed and employers were not allowed to hire replacements.^{1/}

In the next section of the paper a simple model of strikes and wage determination is presented. The model is estimated in Section III and a summary of conclusions is presented in Section IV.

^{1/} A large number of strikes, however, were considered "illegal" because they were called without following the complete legal procedure. Nevertheless they were still regarded and recognized as a legitimate element in the bargaining process. For a description of the legal structure of industrial and labor relations in Chile see U.S. Bureau of Labor Statistics (1969). A comprehensive study of the economic situation and the economic policies in Chile during the complete period studied here is presented by French-Davis (1973).

II. THE THEORETICAL FRAMEWORK

The central aim of this section is to provide a simple framework to explain the incidence of strikes and the process of wage inflation and from which testable implications can be derived and implemented. Like most of the economic analysis of strikes, the formulations are based on the ideas presented in the Aschenfelter and Johnson model where the conditions under which both management and trade-unions maximize their utility by accepting or calling a strike are analyzed. That framework is modified here to allow for the interactions between labor unrest and wage determination and to consider in more detail the role of price expectations in an inflationary context.

The distinction between nominal and real income becomes particularly important in an inflationary environment and the expected rate of price inflation is certain to become a central issue in wage negotiations.^{1/} We need to consider the expected rate of inflation and not its actual rate because wage bargaining takes place at discrete intervals and it is not the current price level that matters in determining the real wage that is being aimed at but the level of prices that is expected to prevail over the period for which the bargain is being struck. However, since labor unions are concerned not only with maintaining, but with the growth

^{1/} Although labor legislation allowed up to two years contract terms, in fact most collective contracts in Chile were signed for one-year terms and therefore required annual renegotiation. The shortness of contract terms stems from the uncertainties of Chile's prolonged inflationary environment which makes unions reluctant to accept longer term wage settlements.

of labor real earnings they are expected to push their nominal wage demands over and above the anticipated rate of inflation in order to obtain wage increases which would permit a rise in real standards of living.

The target increase in nominal wages sought by the union will, therefore, reflect these two elements, i.e. the rate of inflation expected to prevail during the period covered by the labor contract and the increases in real earnings, relative to the previous period, which are desired and are considered feasible to obtain by the unions. In addition to these considerations, it is reasonable to assume that the target nominal wage will be conditioned by the union's assessment of its bargaining strength, which is certainly affected by the situation in the labor market. Therefore, we can assume that the wage-rate increase demanded by the union will be negatively affected by the rate of unemployment. The target nominal-wage increase can, therefore, be formulated as follows:

$$(1) \quad W_t^d = \omega_t^d + p_t^e - \theta U_t$$

where W_t^d is the target rate of growth in nominal wages, i.e. the percentage rate of increase in nominal wages demanded by the union, ω_t^d is the desired increase in real wages (based on the union assessment of productivity, profits and past changes in real earnings), p_t^e is the rate of inflation for period t expected as of the end of $t-1$, U_t is the rate of unemployment and θ reflects the sensitivity of wage demands to the tightness of the labor market.

The target nominal-wage increase which emerges from equation (1) can now be compared with the actual rise obtained during the period. The larger is the gap between the target and the actual increase attained, the larger is the likelihood that labor unrest and labor disputes will break out. Formally:

$$(2) \quad S_t = \alpha(W_t^d - W_t) \quad \alpha > 0$$

where S_t is a measure of strike activity during period t and W_t is the actual rate of growth of money wages during that period. Such increase in nominal wages will itself be affected by the expected rate of inflation and by the strength and vigour with which the union claims are pushed, which can be represented by S_t , the same measure of strike activity used in equation (1). In addition, since the actual rises in nominal wages result, in part, from a compromise between the views of labor and management, they will tend to reflect, at least partially, the increases in real earnings desired by the unions especially when the demands are motivated by increases in labor productivity. Nominal-wage increases can, therefore, be represented by:

$$(3) \quad W_t = \beta p_t^e + \lambda S_t + \phi \omega_t^d \quad \beta \leq 1 \quad \phi \leq 1$$

By substituting (1) and (3) into (2) and solving for S_t and W_t , we can now obtain the reduced forms for strike activity and wage inflation:

$$(4) \quad S_t = \frac{\alpha(1-\phi)}{1+\alpha\lambda} \omega_t^d + \frac{\alpha(1-\beta)}{1+\alpha\lambda} p_t^e - \frac{\alpha\theta}{1+\alpha\lambda} U_t$$

$$(5) \quad W_t = \frac{\phi + \alpha\lambda}{1 + \alpha\lambda} \omega_t^d + \frac{\beta + \alpha\lambda}{1 + \alpha\lambda} p_t^e - \frac{\alpha\theta\lambda}{1 + \alpha\lambda} U_t$$

From equations (4) and (5) we observe that both strike incidence and wage increases are positive functions of the desired changes in real wages and of inflationary expectations and that both are negatively affected by the rate of unemployment. Notice that the higher are β and θ the more will nominal wages increase in response to rises in price expectations and in real-wage demands, and the less will strike activity be affected by those factors. The tendency to strike will always rise with inflationary expectations if the nominal-wage increases fail to fully adjust to the anticipated changes in prices, i.e., $\beta < 1$. The same applies to the effects of ω^d_t .

Equations (4) and (5) can now be directly estimated and that is the subject of the next section.

III. EMPIRICAL RESULTS

III.A. The Unobservable Variables and the Data Used.

Before proceeding to estimate equations (4) and (5) we should discuss briefly the formulation of the empirical proxies for the unobservable variables which appear in the right-hand side of those equations, i.e., for the anticipated rate of price inflation and for the desired rate of growth of real earnings.

Recent literature, mainly on monetary economics, has discussed very extensively the different processes by which price expectations may be

formed based on information currently available to economic agents.^{1/}

We have experimented with a number of alternative formulations although for simplicity the results discussed here are those which correspond to the so-called "partially" rational expectations process.^{2/} The underlying assumption is that during the sample period the inflation process is well modeled by a third-order autoregressive process of the form:

$$(6) \quad P_t = a_1 P_{t-1} + a_2 P_{t-2} + a_3 P_{t-3} + \epsilon_t$$

where P_{t-1} is the annual inflation rate during the year $t-1$, and ϵ_t is the disturbance term which is a serially independent identically distributed random variables with variance σ^2 and zero mean. Given the above process the p_t^e rational anticipation corresponds to the systematic part of equation (6), as such part represents the model's conditional expected value of price inflation. With this specification, equations (4) and (5) are estimated using a two-stage procedure: first equation (6) is estimated and the fitted values are used to generate p^e , and then this proxy is included in the estimation of the strike and wage equations.

Regarding the desired increase in real wages, ω_t^d , a more indirect approach should be taken. The basic hypothesis is that unions, as other sections of society, are growth conscious and are likely to expect increases in real earnings. Their wage behavior is therefore largely conditioned by

^{1/} For extensive references see Frenkel (1977).

^{2/} See Sargent (1973). The results have not shown large sensibility to alternative formulations of inflationary expectations.

their attempt to peg real wages to a target which tends to grow steadily through time. Our assumption is that such target is determined by previous experience, i.e. by the previous achievements in terms of real-wage increases. That hypothesis partially reflects Hicks' view of the process of real wage determination:^{1/}

"The wage earner's test for fair wages is not simply a matter of comparison with other people's earnings; it is also a matter of comparison with his own experience, his own experience in the past. It is this which makes him resist a reduction in his money wage, but it also makes him resist a reduction in the purchasing power of his wage, and even a reduction in the growth of that purchasing power to which he has become accustomed..."

Following that approach we use here an average of actual real-wage gains in the recent past as a proxy for the size of the desired increase in real earnings:^{2/}

$$\omega_t^d = \frac{1}{n} \sum_{i=1}^n (W - P)_{t-i}$$

where n is the number of years considered. There is no compelling reason for the choice of a particular number of years as the base of this average and therefore, alternative values of n were tried and the results reported correspond to n = 5 (which appears to yield the better fit.)

^{1/} See Hicks (1975), page 5. The Chilean experience appears to lend support to this approach. Ffrench-Davis in his analysis of the 1964-70 period comments that previous aspirations and targets of the unions become, once they are achieved, the new starting point for future negotiations. See Ffrench-Davis (1973) p. 59.

^{2/} An alternative approach would be to assume that unions determine their real wage targets by considering what is the maximum increase feasible or attainable. It is reasonable to assume that management will be agreeable to real-wage increases as long as they are correlated with the growth in output per head. Productivity changes may, for that reason, be a sensible approximation for the rises in real wages desired, and regarded as feasible by the unions. Unfortunately, appropriate time-series productivity indexes are not available in a consistent and comparable form for a significantly long period of time.

Regarding the third explanatory variable, the rate of unemployment, two alternative series were used: one provided by ILO, Yearbook of Labor Statistics (Y.L.S.), covering mainly Metropolitan Santiago for the period 1956-1973, and a series estimated by ODEPLAN-CELADE based on a sample of three urban areas for the period 1960-1973. Since the results are similar, the reported are those corresponding to the Y.L.S. series which cover a longer period.^{1/} In addition, results for a longer period but excluding the unemployment variable, are also reported in the tables.

The price index used to deflate wages and to calculate the expected rate of inflation is the CPI (a Food Price Index was also used with very similar results). The wage measure is the yearly average of monthly earnings in manufacturing. Both are taken from the Y.L.S.

Two dimensions of strike activity were examined: (a) frequency, measured by the number of work stoppages per year, and (b) breadth, measured by the number of workers involved in the strikes. Although both variables are certainly related, the correlation between them is far from perfect and some differences in the pattern of results are found. In general, as suggested by Stern (1978, pg. 39) the frequency measure, which represents the decision to take or call a strike, is more responsive to economic conditions than the number of strikers involved, although results for the latter variable are also satisfactory.^{2/}

^{1/} For comparison purposes some results obtained by using the alternative series are also briefly reported.

^{2/} The data is taken from the Y.L.S., various issues and it refers to industrial strikes only.

III. B. The Results

The results of estimating equation (4) for the two strike measures are reported in Table 1. The estimations were performed using different functional forms and those reported here correspond to a semi-log specification.^{1/} Both, frequency and breadth of strike activity are positively and significantly affected, as predicted by the model, by the target rate of growth in real wages and by the expected rate of inflation. The unemployment rate has a negative and significant coefficient in Panel A which indicates that excess supply in the labor market tends to reduce the number of strikes. In Panel B the coefficient also has the correct sign but is not significant, which indicates that the effect of unemployment on strike participation does not seem to be important.^{2/} These results are consistent with Ffrench-Davis' observation that while real earnings increased considerably in the 1964-1966 period, the number of strikes during 1966 was four times higher than in 1959-60.^{3/} Indeed, the increase in the target real wage, coupled with a significant reduction

^{1/} Very similar results were obtained when other specifications were estimated.

^{2/} This result is indeed consistent with previous findings which indicate that unemployment is mainly related to frequency and not to other measures of strike activity. See, for example Skeels (1971) and Vanderkamp (1970). This result is more remarkable when the alternative series of unemployment is used (for the period 1960-1973):

$$\begin{array}{llllll} \text{Log S1} & = & 7.60 & + & 9.62 & \omega_t^d & + & 0.30P^e & - & 0.24U & & R^2 = 0.937 \\ & & (13.66) & & (4.43) & & & (1.63) & & (3.39) & & DW = 1.77 \\ \\ \text{Log S2} & = & 11.31 & + & 12.28 & \omega_t^d & + & 0.67P^e & - & 0.007U & & R^2 = 0.834 \\ & & (15.04) & & (4.19) & & & (2.64) & & (0.07) & & DW = 2.74 \end{array}$$

S1 = frequency S2 = breadth

^{3/} See Ffrench-Davis (1973) p. 62.

TABLE 1

Frequency and Breadth of Strike Activity

Chile, Annual Data

$$(4) \log S_t = a_0 + a_1 \omega_t^d + a_2 P_t^e + a_3 U_t + \eta_t$$

A. Frequency: S_t = number of strikers

Period	Constant	ω^d	P^e	U	$R^2/D.W.$
1953-1973	5.80 (38.88)	13.053 (11.55)	0.736 (2.82)		0.881 1.71
1956-1973	8.02 (10.03)	8.138 (4.80)	0.537 (1.62)	-0.343 (2.83)	0.772 1.20

B. Breadth: S_t = number of workers involved

Period	Constant	ω_t^d	P^e	U	$R^2/D.W.$
1953-1973	11.51 (76.50)	9.148 (8.02)	0.777 (2.95)		0.785 2.41
1956-1973	12.52 (15.02)	5.970 (3.37)	0.648 (1.84)	-0.158 (1.25)	0.581 1.45

Notes: OLS estimates. t values are in parentheses below the coefficients.
n = 3 in equations for the 1956-1973 period.

in the unemployment rate, may help to explain such increase in labor unrest.

The results of estimating equation (5), the rate of growth of nominal wages, are also very favorable to the hypotheses postulated in Section II. They show a strong effect of expectations on the nominal wage determination and also a positive effect of the target growth of real wages, which can be related to trend growth in labor productivity. The coefficient of the rate of unemployment is, as expected, negative and significant.

As a whole, the results tend to support the idea that strike activity and wage inflation are jointly determined by the expectations of workers regarding the growth in their real earnings and regarding erosion of the purchasing power of their nominal wages, and they are also affected by the tightness of the labor market as reflected by the rate of unemployment. Those effects are observed to persist under different specifications and for different periods of time.

III.C. Changes in the Pattern during the Allende Government (1971-1973)

It is perhaps unreasonable to assume that the relationships between economic indicators and strike activity can actually be studied over a period of several years without making some explicit allowance for the fact that the nature of the bargaining process may have been affected by changes in the political context within which such process takes place.

TABLE 2

The Rate of Growth of Nominal Wages

Chile, Annual Data

$$(5) W_t = h_0 + h_1 \omega_t^d + h_2 P^e + h_3 U^t + \eta_t$$

Period	Constant	ω^d	P^e	U	D	$R^2/D.W.$
1953-1973	-0.56 (0.06)	1.677 (2.36)	0.938 (5.76)			0.654 1.92
1956-1973	61.42 (35.55)	0.372 (1.72)	0.975 (4.99)	-10.708 (1.98)		0.670 2.15
1953-1976	2.43 (0.29)	0.824 (1.75)	0.766 (4.76)		41.87 (2.45)	0.744 2.27

Note: For the value of D, see Table 3.

In the Chilean case an obvious change of that sort is the socialist government of President Allende whose Administration is included in the last three years of our sample.

One simple way of quantifying the effects of the change in regime is to re-estimate equations (4) and (5) with the addition of scale and slope dummies for the specific period during which a structural change may have taken place. Dummies were thus assigned a value of 1 during the Allende presidency, i.e. the last three observations of the sample and zero otherwise.

The results reported in Table 3 for strike activity and in Table 2 for the nominal wage, show that the years of the Allende government have indeed a measurable consequence upon the relationships, indicating a higher frequency of strikes and a more rapid rate of growth of nominal wages (D, the scale dummy is significant in both cases). The relationship for the number of strikers, however, does not appear to be significantly affected by the change in administration.^{1/}

The slope dummies used here to assess the effects of the change in regime upon each one of the specific coefficients, are in general not

^{1/} It is clear that political factors have played a particularly important role in explaining the significant shift in the relationships which are captured by the scale dummy. It is also possible that there was a significant change in the sectoral incidence of strikes during the period although our equations are not sensitive to those changes. In addition, during the Allende period the number of workers involved in each strike was substantially lower than the sample mean, particularly during 1971-72.

TABLE 3

Frequency and Breadth of Strike Activity

Changes in the Pattern During 1971-73

$$I. \log S_t = b_0 + b_1 \omega_t^d + b_2 P_t^e + b_3 D_t + \epsilon_t$$

$$II. \log S_t = b_0 + b_1 \omega_t^d + b_2 P_t^e + b_3 D_t \omega_t^d + \epsilon_t'$$

$$D_t = 0 \quad \text{for } t = 1953-1970$$

$$D_t = 1 \quad \text{for } t = 1971-1973$$

A. Frequency: S = number of strikes

	Constant	ω^d	P^e	D	$D\omega^d$	$R^2/D.W.$
I.	5.83 (40.63)	11.70 (8.96)	0.534 (1.93)	0.492 (1.68)		0.893/1.650
II.	5.79 (41.88)	11.740 (9.45)	0.608 (2.43)		5.090 (1.97)	

B. Breadth: S = number of workers involved

	Constant	ω^d	P^e	D	$D\omega^d$	$R^2/D.W.$
I.	11.51 (73.64)	9.012 (6.29)	0.755 (2.51)	0.052 (0.16)		0.786/2.41
II.	11.51 (74.35)	9.143 (6.58)	0.776 (2.77)		0.002 (0.006)	0.785/2.41

significant. The slope dummies for P^e and U are not significant in any regression, and therefore those results are not reported. The slope dummy for ω_t^d is significant only in the strike-frequency equation. The coefficient in that equation is relatively large which suggests a much larger sensitivity of strikes (as measured by the frequency) to changes in the target real wage. Not such strengthening of the relationship is observed when the number of strikers is considered.

IV. SUMMARY

Using quantitative methods we have studied the factors affecting the joint determination of strike activity and wage inflation in Chile during the period 1953-1973. The main conclusions of this study can be summarized as follows:

1. Strike activity measured by both the frequency and the number of workers participating, are positively and significantly affected by the expected rate of inflation and by the target rate of growth in real earnings. The same factors also have a significant effect on the rate of change of nominal wages.

2. An increase in the rate of unemployment has a negative effect on the number of strikes and depresses the rate of growth of nominal wages. It does not appear to affect the number of workers participating in labor disputes.

3. The socialist government of S. Allende (1971-1973) is associated with a positive shift in the estimated equations for strike frequency and for the rate of growth of nominal wages. The relationship for the breadth of strike activity remains stable over the period. During the Allende Government the number of strikes become more sensitive to changes in the target growth rate of real wages.

From these results it is apparent that despite the variety of political and social factors involved in the determination of strikes and stoppages, economic factors still play a major role in the explanation of the incidence and breadth of labor conflicts. Therefore an analytical

framework like the one presented above can prove helpful to study the process of wage and price inflation in other countries with similar experience.

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