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Article abstract

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Recent research on trade union growth has increasingly favoured econometric model-building and testing as «the preferred way to advance knowledge»[1]. Variations in aggregate union membership and its determinants have been the subject of a number of econometric studies in the past decade and a half[2]: the two seminal works are the analysis by Ashenfelter and Pencavel [hereafter A/P (1969)] of American trade union growth over the period 1904-1960 and the monograph by Bain and Elsheikh [B/E (1976a)] which attempts to build a general model of union growth from studies of the aggregate pattern of change in union membership in Australia, Sweden, the U.K. and the U.S. over several decades. While these studies have contributed to a resolution of the debate over the relative roles of the business cycle and political, social and institutional factors in union growth, they have been criticized for theoretical, methodological and statistical shortcomings[3]. Major criticisms relate to structural instability of

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1 ROOMKIN and JURIS, (1982), p. 311.

2 Reviews of these econometric studies may be found in FIORITO and GREER, (1982), and ROOMKIN and JURIS, (1982).

3 See BAIN and ELSHEIKH (1976a), FIORITO and GREER (1982), DUNLOP and GALENSON (1978), MANCKE (1971), MOORE and NEWMAN (1974), MOORE and PEARCE (1976), ADAMS and KRISLOV (1974), KASSALOW (1980), and SHEFLIN et al(1981).

the models, inappropriate specification of the explanatory variables, and the neglect of such important factors in union growth as the changes in labour legislation and in composition of the labour force affecting the opportunities to organize.

Although there is evidence of an upsurge of empirical work on the explanations of union membership growth in the United States, and other countries there has been very little research in Canada in this field. Comparative international studies, like the B/E study, generally do not cover Canada on the ground that «Canadian business and union activity is less fundamental in the sense that much of it is transmitted from the United States»[4], ignoring the many differences in legislative framework and union organization environment in the two countries[5]. The few independent studies that have focussed on Canadian union growth[6], using econometric tools and techniques, are either incomplete and ad hoc, or do not cover the 1970s, the period of rapid membership growth[7].

The objective of this paper is to fill the serious gap in our empirical knowledge of the determinants of union growth in Canada. We specify a model which builds on the strengths of the A/P and B/E models and incorporates the effects of legislative changes, shifts in labour force composition and the rate of change in the U.S. union membership. The empirical performance of the model is then assessed with an estimating equation to explain the aggregate union membership growth in Canada over the period 1935-1981. The predictive ability, in particular the inter-temporal stability of the model is compared and contrasted with the estimates of the A/P and B/E models.

MODEL SPECIFICATION

There appears to be a general consensus in the recent industrial relations literature that the trends and patterns of union membership growth can be best understood in terms of its «total environment»[8]. Four groups of factors are held responsible for variations in union growth through their im-

4 BAIN and ELSHEIKH (1967a), p. 3.

5 Discussed in WEILER (1983), MELTZ (1985), CHAISON and ROSE (1985) and LYON (1977).

6 See SWIDINSKY (1974), BAIN and ELSHEIKH (1976b), ABBOTT (1982), and CHAISON and ROSE (1981).

7 Aggregate union membership increased by 56.3 percent between 1970-1980 compared with 48.9 during 1960-1970 and 41.8 in 1950-60. Union density over this period was up from 28.4 in 1951 to 32.3 in 1960, 33.6 in 1970 and 37.6 percent in 1980.

8 See KOCHAN (1980), p. 133; BLUM (1968), p. 48; and BLOCK and PREMARK (1983), pp. 64-66.

pact on the propensity and the opportunity to organize: (1) economic stability factors including the rate of change of prices, wages or both, employment growth, and the change in unemployment; (2) public policy changes affecting union organization and collective bargaining coverage through various legislative and related administrative rules and regulations; (3) structural factors such as the extent of present trade union organization and the changes in demographic and industrial/occupational composition of the labour force; and finally (4) internal organizational factors such as union leadership, resources and approaches, management behaviour and strategies etc.[9].

Both the A/P and B/E models emphasize economic stability factors as the key determinants of union membership growth although proxy variables related to the effects of legislation and the extent of unionization are included in the empirical estimation as incidental factors. The functional specifications of the two models also provide for lagged effects as well as non-linear and asymetrical relationship between dependent and independent variables. A/P relate trade union membership growth to the rate of change in prices, the lagged change in employment in unionized sectors of the economy, the rate of unemployment in the preceding trough of the business cycle as a proxy for workers' stock of grievances, the proportion of employment in the union sector that is already unionized capturing the possible saturation effect, and an index of legislative sentiment. The general determinants of union membership growth according to the B/E study are ~~the rate of change in prices, the rate of change in wages,~~ the level and/or rate of change in prices, the rate of change in wages, the level and/or rate of change in unemployment, and the level of union density. The socio-political factors are considered to have only an indirect impact upon union growth; the exceptions are the United States and Australia where B/E find government action has had a significant impact on union growth. B/E further suggest that the functional forms and lag structures of the explanatory variables vary from one country to another.

Equations (1) and (2) present specifications of the A/P and B/E models incorporating political and social variables relevant for Canada:

Modified A/P Model

$$\text{Eq. (1)}\quad \Delta T_t = b_0 + b_1 \Delta P_t + b_2 \Sigma \Delta E_{t-i}\,(i=0,1,2,3) + b_3 (T/E)_{t-1}^{-1} + b_4 D44_t + b_5 DD_t (UR\text{-}UR^*)_t$$

where $b_1, b_2, b_3, b_4, b_5, > 0$

9 See REZLER (1961) for a classification of factors affecting union growth.

Modified B/E Model

Eq. (2) $\Delta T_t = b_0 + b_1 \Delta P_t + b_2 (\Delta P \bullet DS)_t + b_3 (\Delta U \bullet DB)_t + b_4 (\Delta U \bullet DD)_t + b_5 \Delta RW_t + b_6 (T/E)_{t-1}^{-1} + b_7 D44_t$

where $b_1, b_5, b_6, b_7 > 0$ and $b_2, b_3, b_4 < 0$

The dependent variable in both equations, ΔT_t, is the annual rate of change in aggregate union membership. The five independent variables in equation (1) are price inflation, ΔP_t; employment growth, ΔE_t; lagged union density[10] (inverted form), $(T/E)_{t-1}^{-1}$; the legislative dummy variable, $D44_t$; and the proxy variable for worker discontent, $DD_t(UR\text{-}UR^*)_t$. The empirical specification of ΔE_t includes a three-year unrestricted distributive lag structure on current and past employment change on the assumption that the response of union growth to changes in employment is complete within three years. The variable $D44_t$ is a binary dummy variable which takes the value one for the years following the proclamation of PC 1003 in late 1943; it is specified to equal zero for the years prior to 1944. The variable is intended to measure the impact of change in the legislative framework for union organization embodied in the Privy Council Order 1003; the Order gave Canadian workers (on the lines of the Wagner Act in the United States) the right to organize and bargain collectively and a procedure for the certification of bargaining units. The worker discontent variable, $DD_t(UR\text{-}UR^*)_t$, an interactive variable measuring the effect on union growth of the workers' «stock of grievances», consists of a dichotomous element, DD_t, which takes on the value one in years when the economy contracts and zero in years of business expansion, and a measure of the severity of economic recession, $(UR\text{-}UR^*)_t$ where UR_t is the unemployment rate in year t and UR^*_t is the rate of unemployment in the most recent year with a cyclical peak[11]. This specification of the worker discontent effect is slightly different from Ashenfelter and Pencavel: while the A/P specification suggest that worker grievances accumulate during business recession and changes in union membership due to this accumulation only occur when the

10 As BAIN and ELSHEIKH (1976a) point out, «union density has to be lagged one period in order to avoid introducing a spurious correlation between it and the dependent variable». (p. 70n)

Both A/P and B/E studies also use the linear specification of union density, $(T/E)_{T-1}$, in their estimations. However, following early experiments which showed the clear superiority of the non-linear $(T/E)_{t-1}^{-1}$ over its linear alternative we chose to report only the results using the non-linear specification.

11 The years in which DD_t equals one are: 1938, 1946, 1949, 1951, 1957-1958, 1961, 1975, 1980. All other years have DD_t equal to zero.

recovery is under way, the specification in this study assumes a more immediate response by workers to the dislocation and insecurity of economic troughs, such that union growth would occur at the time of the economic contraction[12]. Percentage change variables used in the equations are computed in the conventional manner, rather than with A/P's unorthodox method[13].

The seven independant variables in equation (2) are ΔP_t, $[T/E]_{t-1}^{-1}$ and $D44_t$, and the dummy price inflation variable $(\Delta P \cdot DS)_t$ which has two components, the current rate of inflation and a dummy variable, DS_t, that takes the value one when the rate of increase in consumer prices is 7 percent or higher and otherwise has the value zero[14]; and the rate of change in real wages, ΔRW_t, or the percentage change in the ratio of money wages and the Consumer Price Index[15]. The unemployment variables are $(\Delta U \cdot DB)_t$ and $(\Delta U \cdot DD)_t$ with ΔU_t as the change in number of unemployed and dichotomous factors DB_t and DD_t such that DB_t takes the value one in a year containing a business cycle peak and zero otherwise; DD_t has the value one in years of economic contraction and zero otherwise[16]. Through these

12 This specification of the «stock of grievances» variable is proposed by ABBOTT (1982).

13 In most empirical work the convention is to calculate the percentage change of any variable using the level from which the change begins as the denominator in the calculation. In the ASHENFELTER and PENCAVEL, as well as the BAIN and ELSHEIK, studies percentage change in various data series is calculated with the level at which the change ends as the denominator. Since the value of the dependent as well as several independent variables rises significantly over time, the A/P and B/E method gives lower mean, variance and range of variables.

14 The years when DS_t is equal to one are 1947, 1948, 1951, and 1973-1981 inclusive.

The 7 percent threshold was selected on the basis of the average increase in the Consumer Price Index over the period 1935-1981. ABBOTT (1982) proxies the non-linear price-union growth relationship by the square of ΔP_t along with ΔP_t itself. Our experiments using the quadratic form in prices failed presumably because the non-linearity is sharper than the quadratic form implies.

In a recent review of the literature FIORITO and GREER (1982) consider this non-linearity in the inflation-union growth relationship an «apparent paradox», a worthy subject for further investigation (p. 18).

15 The correlation between changes in nominal wages and the change in consumer prices, ΔP_t over the 1935-1981 sample period was r = .8469. Similarly nominal wages were highly correlated with the slope shifting price variable $(\Delta P \cdot DS)_t$ where r = .7301. The comparable correlation between the change in real wages, ΔRW_t, and ΔP_t over the sample period was r = -.4499; the correlation between ΔRW_t and $(\Delta P \cdot DS)_t$ was r = -.5096.

16 The specification follows SHISTER (1953), p. 415, «But, if employment expansion in the upswing of the cycle entails an expansion in union membership, it does not follow that the downswing of the cycle entails a decline in membership commensurate with the decline in employment. Quite the contrary, over time the reductions in membership during cyclical declines in employment tend to become proportionately smaller. We might call this the long-run asymmetry of the cyclical reductions in trade-union membership».

Shister believed this asymmetry stemmed from the benefits unions provided unemployed members, the initiation fees required to rejoin a union if membership was permitted to lapse and the use of seniority as a major factor in determining layoffs, recalls and promotions.

interactive variables the observations of ΔU_t are divided between upswings and downswings of the business cycle to permit the study of the asymmetric effects of unemployment on union growth[17].

Although A/P and B/E models are judged successful by conventional statistical criteria in providing a reasonably good explanation of the historical pattern of union membership growth, they have been criticized for their many shortcomings, in particular for omitting important structural and public policy variables. Both models rely heavily on business cycle explanations of union growth, ignoring totally the impact of such structural changes in the labour force as the inter-industry shifts in employment, the steady decline in the importance of blue-collar occupations, or the growing proportion of women workers. The relative significance of strutural factors in the historical pattern of union growth has been well documented in the literature, and in cross-sectional studies of union growth[18]. Furthermore, casual evidence indicates that labour unions in Canada and elsewhere have been generally less successful in organizing women and others employed in service industries with the exception of workers in the public sector. Similarly time-series analysis based on the two models tends to view the effects of legislation as only incidental rather than a key causal factor in union growth. It has been argued that the legislative changes may affect not only the rate of increase in union membership but also the saturation effect of the existing level of union organization. A recent review of the literature concludes that «one source of structural instability that plagues most time-series models seems to be the failure to provide for changes in labour laws»[19]. The two models, in their attempt to formulate a general theory of union growth, also do not provide for certain unique characteristics of national labour movements. For example, in the case of Canada, international unions with headquarters in the United States have played a key role in the organization and development of the Canadian trade union movement. It is no surprise, therefore, that most Canadian studies of union growth have included the rate of change in U.S. membership as an explanatory variable[20].

17 BAIN and ELSHEIKH (1976a, p. 90) specify two asymmetric unemployment variables when testing their model with United States data, one with a value zero when unemployment was rising and the other with a non-zero value when unemployment was falling. Also see SHEFLIN et al (1981) who use the same specification.

The years in which DD_t equals one and DB_t equals zero are: 1938, 1946, 1949, 1951, 1954, 1957-58, 1961, 1975, 1980.

All other years have DD_t equal to zero and DB_t equal to one.

18 In particular see the pioneering contributions of DUNLOP (1948) and SHISTER (1953). For a review of cross-sectional studies see FIORITO and GREER (1982): the reviewers argue that «sex, education and occupation-related effects have been repeatedly detected in cross-sectional studies and should be considered in future time-series analyses of union growth» (p. 17).

19 FIORITO and GREER (1982), pp. 14-15.

20 See for example SWIDINSKY (1974) and ABBOTT (1982).

Against the background of the shortcomings of the A/P and B/E models we specify in equation (3) an alternative model which builds on the strenghts of the A/P and B/E models and incorporates omitted variables relevant for Canada. Our model relates union membership growth to the linear and non-linear changes in prices, lagged employment growth, changes in unemployment during cyclical expansions and contractions, the percentage change in real wages, the level of union density, the rate of change in union membership in the United States, legislative changes following the passage of Order-in-Council PC 1003, and the changes in the ratio of employment in service and goods-producing industries and in the ratio of female and male employment.

Alternative union growth model

$$\text{Eq. (3)}\quad \Delta T_t = b_0 + b_1 \Delta P_t + b_2 (\Delta P \bullet DS)_t + b_3 (\Delta U \bullet DB)_t + b_4 (\Delta U \bullet DD)_t + b_5 \Delta RW_t + b_6 (\Delta TUS \bullet I/N)_t + b_7 \Delta E_{t-2} + b_8 [T/E]^{-1}_{t-1} + b_9 \Delta(F/M)_t + b_{10} \Delta(S/G)_{t-1} + b_{11} D44_t + b_{12} D44_t \bullet [T/E]^{-1}_{t-1}$$

where $b_1, b_5, b_6, b_7, b_8, b_{11} > 0$ and $b_2, b_3, b_4, b_9, b_{10}, b_{12} < 0$

The dependent variable, ΔT_t, and the independent variables ΔP_t, $(\Delta P \bullet DS)_t$, $(\Delta U \bullet DB)_t$, $(\Delta U \bullet DD)_t$, ΔRW_t, ΔE_{t-2}, $(T/E)^{-1}_{t-1}$, and $D44_t$ are the same as in equations (1) and (2). New independent variables included are the rate of change in union membership growth in the United States adjusted by a ratio of Canadian membership in international unions to membership in national unions[21], $(\Delta TUS \bullet I/N)_t$; the change in the ratio of female to male non-agricultural paid employment, $\Delta(F/M)_t$; the change in the ratio of service industry to non-agricultural goods-producing industry employment, lagged one year, $\Delta(S/G)_{t-1}$[22]; and the interactive variable $D44_t \bullet (T/E)^{-1}_{t-1}$. The interactive term is included to test the hypothesis that the level of density at which the saturation point in union growth is reached is dependent on the public policy environment. It is argued that the cost of union member-

21 The adjustment was made to take into account the steady decline in the proportion of union members affiliated to the international unions with headquarters in the U.S. — the primary institutional link between Canadian — American unionism. International unions accounted for 80-90 percent of total Canadian union membership in the 1910s and 1920s. The proportion of their membership in total fluctuated between 51 and 72 in the 1930s and 1940s, was in the 70 percent range in the 1950s and early 1960s and has been declining for the past two decades reaching a record low of 43 percent in 1981-82.

22 The industry groups included in the «service» industries category are wholesale and retail trade, finance, insurance and real estate, community, business and personal services, and public administration. Included in the goods industries category are mining, forestry, manufacturing, construction and transportation, communications and other utilities.

ship may outweigh the potential benefits from unionization under an unfavourable legislative framework. Under such conditions saturation may be reached at a relatively low level of union density. The saturation point may shift upwards with favourable public policy changes which reduce the cost of union membership by facilitating easier union certification, encouraging union security provisions or by limiting employers' ability to interfere in workers' choice. In the Canadian case, PC 1003 in 1944 may have altered the saturation effect of existing union density on the rate of increase in union membership. The hypothesis to be tested was that the effect of union density on union growth prior to 1944 was different from the effect after 1944. The hypothesis implies a negative coefficient on the interaction variable and positive coefficients on both non-linear union density and legislative dummy variables.

EMPIRICAL ESTIMATES

The empirical estimates of the three equations, by Ordinary Least Squares (OLS) regression, for the period 1935-1981 are shown in Table 1[23]. Columns (1) and (2) include the estimation results of modified A/P and B/E models while column (3) presents the estimates of our alternative model of union growth.

The OLS estimates of equations (1) and (2) indicate that both A/P and B/E models describe reasonably well the historical pattern of aggregate union membership growth in Canada, judging by the criteria of the goodness of fit (R^2) and the statistical significance of estimated regression coefficients. The two equations are able to explain almost three-fourths of the variation in union membership growth since 1935. All explanatory variables have the expected sign, and most are statistically significant at the 95 percent probability level.

The three most significant factors in union growth, according to the original A/P study are price inflation, lagged employment growth and worker discontent. However, equation (1) shows that employment growth and the legislative framework provided by PC 1003 in 1944 have been the key factors shaping union growth in Canada. Estimates further indicate that a one percent increase in employment (over a three year period) leads to

23 The sample period 1935-1981 was dictated by the availability of consistent data. For example the series on non-agricultural paid workers (NAPW) begins only in 1931 and all the data are used in the four year lag structure of the employment change variable. We believe that a fair comparison of the three models could only be made if the data used in each estimated equation were consistent.

TABLE 1

Estimates of the Three Union Growth Models for Canada 1935-1981

Explanatory Variables	*The A/P Model Equation (1)*	*The B/E Model Equation (2)*	*The Alternative Model Equation (3)*
Constant	-36.53	-24.65	-35.31
	(4.58)	(3.15)	(3.64)
ΔP_t	0.45	2.25	1.40
	(2.80)	(5.80)	(4.57)
$(\Delta P \cdot DS)_t$		-1.29	-0.88
		(3.71)	(3.54)
$(\Delta P \cdot DB)_t$		-0.17	-0.14
		(4.60)	(4.86)
$(\Delta P \cdot DD)_t$		-0.005	-0.002
		(0.218)	(0.07)
ΔRW_t		1.43	0.71
		(4.34)	(2.48)
ΔE_t	1.61		
	(7.70)		
ΔE_{t-1}	0.35		
	(1.95)		
ΔE_{t-2}	0.59		0.69
	(3.72)		(5.23)
ΔE_{t-3}	0.19		
	(1.31)		
$\Sigma \Delta E_{t-i}$	2.74		
$(i = 0,1,2,3)$	(8.33)		
$(\Delta TUS \cdot I/N)_t$			0.22
			(3.35)
$\Delta(F/M)_t$			-0.38
			(3.37)
$\Delta(S/G)_{t-1}$			-0.34
			(4.05)
$(T/E)^{-1}_{t-1}$	564.50	383.80	485.90
	(4.55)	(3.03)	(3.13)
$DD_t(UR-UR^*)_t$	1.27		
	(1.74)		
$D44_t$	11.89	7.69	33.93
	(3.23)	(2.09)	(3.02)
$D44_t \cdot (T-E)^{-1}_{t-1}$			-511.90
			(2.50)
R^2	0.765	0.745	0.896
R^2 adjusted	0.716	0.699	0.859
S.E.E.	3.554	3.657	2.500
F-stat	15.480	16.259	24.425
D.W.	1.724	1.940	2.021

Note: The numbers in brackets are the absolute values of the coefficients «t-statistics».

an increase of approximately 2.74 percentage points in union membership; declining coefficients on the employment variable suggest that over 90 percent of the response of union growth to employment change takes place within two years. The coefficient of the union density variable appears to provide confirmation of the «saturation effect» hypothesis. The coefficient estimate of ΔP_t implies a positive relationship between price inflation and union membership growth.

The coefficient of the «stock of grievances» variable, $DD_t(UR\text{-}UR^*)_t$, while consistent with *a priori* reasoning, is statistically significant only at the 90 percent level. The weak significance of this variable suggests three alternative explanations. First, it is possible that workers' discontent has had very little influence on trade union growth in Canada since 1935. Second, one might argue that only a prolonged period of economic contraction such as the Great Depression could generate the level of «grievances» and the desire to protest necessary to spur union growth. This would follow Dunlop's (1948) argument concerning «periods of fundamental unrest» where serious economic conditions bring about the questioning of the fundamental tenets of society and thus lead to union growth. Third, the aggregate unemployment rate may be a very poor proxy for a «stock of grievances» variable in Canada and another series of observations may be better suited.

The estimates of the modified B/E model (equation 2) suggest that among the key economic variables, inflation and real wage growth have an overwhelming influence on union growth. The impact of inflation on union membership growth is however non-linear; low levels of price inflation spur union membership growth but the rate of increase in aggregate union membership is dampened at high rates of inflation. The coefficient estimates of ΔP_t, $(\Delta P \cdot DS)_t$ and ΔRW (the change in the ratio of nominal wages and prices) imply that a one percent rate of inflation, when the price increase is less than 7 percent, is associated with a 0.82 percentage point increase in aggregate union membership; when price inflation is equal to or greater than 7 percent the union membership growth decline by one-half of one percent for every percentage point rise in the price level[24]. Estimates of

24 To calculate the approximate partial effect of prices on trade union growth implied by equation (3) one may rewrite the appropriate part of the equation,

$$\Delta T_t = \ldots + 2.25\,\Delta P_t - 1.29\,(\Delta P \cdot DS)_t + 1.43\,(\Delta W\text{-}\Delta P)_t + \ldots$$

$$\text{thus} \frac{\delta \Delta T_t}{\delta \Delta P_t} = 2.25 - 1.29\,DS_t - 1.43$$

$$\text{if } \Delta P_t < 7, \text{ie } DS_t = 0, \text{ then} \frac{\delta \Delta T_t}{\delta \Delta P_t} = 0.82$$

$$\text{if } \Delta P_t \geq 7, \text{ ie } DS_t = 1, \text{ then} \frac{\delta \Delta T_t}{\delta \Delta P_t} = -0.47$$

the model also indicate that nominal wage changes influence aggregate union membership independent of the rate of inflation. Changes in unemployment, according to the estimates of equation (2) also affect union growth but the impact is very small and asymmetric[25]. The asymmetric relationship is captured by the coefficients of two unemployment variables, $(\Delta U \cdot DB)_t$ and $(\Delta U \cdot DD)_t$, which show the differential effects on union growth of changes in unemployment during the two phases of the business cycle. While the estimated coefficent of $(\Delta U \cdot DD)_t$ is very small and statistically insignificant, the coefficient of $(\Delta U \cdot DB)_t$ is large and significant at the 99 percent probability level. Coefficients of the two unemployment variables suggest that rising unemployment during a cyclical contraction has negligible effect on union growth. However, a fall in unemployment during the expansionary phase of the cycle, that is when ΔU_t is negative, has a positive impact on union membership growth. The coefficient of $(\Delta U \cdot DB)_t$ further suggests that a rise in unemployment during an expansionary cyclical phase reduces union growth.

The empirical estimates of the equation (3) which includes, among others, both business cycle and structural change variables, show that our alternative model is a vast improvement over the A/P and B/E models in both the specification of various explanations of union growth and in predictive ability. The model is able to explain almost ninety percent of the aggregate union membership growth in Canada during the period 1935-1981. All regression coefficients in the equation have the expected sign and, except for one of the unemployment change variables, are statistically significant at the 95 percent probability level providing strong support of the proposed hypotheses.

The estimates suggest that among the economic stability factors, price inflation, real wage growth and lagged employment growth have the most influence on union membership growth, reinforcing the need to integrate A/P and B/E specifications. The coefficients of ΔP, ΔRW and $(\Delta P \cdot DS)_t$ confirm B/E reasoning that both prices and wages have a separate and distinct impact on union growth: the partial effect of prices is approximately 0.69 and the effect of wages, i.e. after controlling for price inflation, is 0.71. The estimates also support the B/E hypothesis that the effect of changes in the price level on union growth is non-linear, i.e. when the rate of inflation is 7 percent or less, a one percent increase in consumer prices leads to about a 0.69 increase in aggregate union membership growth but at higher (7 percent or more) levels of inflation the impact on union growth is negative. The estimates of equation (3) similarily confirm the asymmetric

25 The general relationship between changes in unemployment and union membership growth is inverse. The coefficient of ΔU_t was -0.056 with a t-value of 2.42.

relationship between changes in unemployment and aggregate union membership growth hypothesized by B/E. The coefficient of employment variables suggests that the rate of change in employment also has a significant impact on unionism, independent of the effect of unemployment. Employment growth, it appears, changes the potential for union membership and affects union growth with a two year lag: the partial effect of employment growth is 0.69, similar to the effect of inflation on union growth.

The coefficients of all the three structural change variables in equation (3) support the hypotheses that changes in the composition of the labour force by industry and sex and the existing level of union organization have had *ceteris paribus* a dampening effect on aggregate union membership growth in Canada; both the coefficients of change in the ratios of services to goods industries employment and of female to male employment are negative and statistically significant at the 99 percent probability level. Similarly, the positive coefficient of the inverse of the one-year lagged density variable supports the saturation effect phenomenon, i.e. a further increase in aggregate union membership becomes difficult at higher levels of union organization. (It should be noted that the estimated coefficient of the union density variable represents the «pure» saturation effect, after controlling for the inter-relationship between changes in the legislative framework following the introduction of PC-1003 and the existing level of union organization as well as the impact of inter-industry and male-female employment shifts.)

The estimated coefficients of the public policy variable $D44_t$ and the interactive public policy-union density variable, $D44_t \cdot (T/E)_{t-1}^{-1}$, suggest that the enactment of PC 1003 in 1944 had a dual effect on union membership growth: not only did it have a positive impact on aggregate union membership growth but it also eliminated the saturation effect associated with the union density levels prior to 1944. Coefficients of both the $D44_t$ and the union density variable $(T/E)_{t-1}^{-1}$ as well as the interactive term $D44_t \cdot (T/E)_{t-1}^{-1}$ have the expected sign and are statistically significant at the 95 percent level. The coefficients imply that while the existing levels of union organization prior to 1944 had a dampening effect on the rate of increase in aggregate union membership, there does not appear to be any evidence of the saturation effect after 1944.

Following the confirmation of our hypothesis that favourable public policy changes in 1944 altered the saturation effect of existing union density on the rate of increase in union membership, we also studied the effects of legislative changes in the late sixties extending bargaining rights to public sector workers beginning with amendments to the Québec Labour Code in

1964. Two hypotheses were tested: first, that there was an autonomous shift in the rate of increase in union membership after 1964; and second, that the saturation effect of union density during the post-war years, following the passage of PC 1003, was further altered by the wave of public sector legislation since 1964. To test the two hypotheses a second dichotomous variable $D44B_t$ was added to take the value one in years 1965-1981 and the value zero for the period 1935-1964. Similiarly another interaction variable, $(T/E)^{-1}_{t-1} \cdot D44_{Bt}$, a product of the reciprocal of the union density variable $(T/E)^{-1}_{t-1}$ and the dichotomous legislative change variable ($D44_{Bt}$) was added. Equation (3), including these two new variables, was then re-estimated for the period 1935-1981 using Ordinary Least Squares. Both variables came statistically insignificant, indicating that the legislative changes after 1965 had no significant independent impact on either union growth or union density.

Finally, the empirical estimates of our alternative model equation (3) show a positive and statistically significant coefficient of the variable measuring the effect of the rate of change in U.S. aggregate union membership growth adjusted for the proportion of Canadian membership in international unions. The estimated coefficient suggests that union membership growth in Canada has been affected by union growth in the United States. This spillover effect, a product of the historical institutional links between the labour movements in the two countries, appears dominant even today despite a marked decline in the proportion of union membership in Canada affiliated with international unions with headquarters in the United States.

Structural Stability

The structural stability of union growth models has been a primary concern of researchers. Recently Sheflin et al (1981) subjected both A/P and B/E frameworks to the «non-linear, maximum likelihood approach suggested by Quandt [1958,1960]» and inferred that the models were «averages of two different equations, and as such are of limited usefulness».

Following these concerns we applied four procedures on the three estimated models for Canada to seek evidence of instability: Quandt's [1958,1960] maximum likelihood procedure, the split sample and sequential Chow (1960) tests, and the cusum-of-squares test proposed by Brown, Durbin and Evans (1975). The results of the four tests of parameter constancy indicated that each of the three equations tested show some degree of instability. The A/P model provided evidence of instability in all four procedures, rejecting the null hypothesis of parameter stability at the ten per-

cent level in the split-sample Chow test and the one percent significance level in the sequential Chow and the cusum-of-squares tests. The B/E equation, gave indications of instability in three procedures — the maximum likelihood (ML) procedure, the sequential Chow test and the cusum-of-squares test. The alternative model equation, rejected only the null hypothesis of stability in the sequential Chow test and this rejection was significant at the 5 percent level but not at the one percent level[26]. Thus our tests for parameter constancy suggest that the A/P and B/E models represent less stable relationships between union growth and its determinants than the alternative framework which we have proposed.

SUMMARY AND CONCLUSIONS

The purpose of this paper has been to explore the key determinants of aggregate union membership growth in Canada, using econometric analysis. To this end we developed a model of union growth which builds on the strengths of the popular A/P and B/E models and incorporates several hypotheses relating to the effects on aggregate union membership of changes in key business cycle variables, the legislative framework, and the inter-industry and male-female composition of the labour force. The empirical performance of the model, as well as the A/P and B/E models, was assessed on the rate of change in aggregate union membership in Canada during the period 1935-1981. Our empirical estimates suggest that the alternative model is a vast improvement over the A/P and B/E models in both the specification of various explanations of union growth and the predictive ability. By combining the key variables and the unique functional forms of relationships in the A/P and B/E models and augmenting them with structural change and public policy variables of importance to the Canadian labour movement, the alternative model provides a better explanation and more precise coefficient estimates of major economic and non-economic factors that have shaped Canadian union growth since 1935. The estimated equation is also able to explain nearly 90 percent of the variation in aggregate union membership growth in Canada over the sample period 1935-1981.

According to the model the historical pattern of union membership growth in Canada since 1935 can be explained by a combination of three groups of factors: economic stability factors such as inflation, unemployment, real wage growth and lagged changes in total non-agricultural employment; the public policy or legislative framework for union organiza-

26 The results of these tests as well a residuals analysis of the three models are available from the authors or see KUMAR and DOW (1984).

tion and collective bargaining embodied in PC 1003; and finally structural factors such as the extent of present union organization and changes in demographic and industrial distribution of the labour force. Estimates of the model suggest that the relationship between union growth and various economic and non-economic factors is both linear and non-linear as well as asymmetric and interactive, a reflection of the dynamic character of the growth process. Various tests of stability performed on the model estimations also indicate that the alternative model is less instable than the A/P and B/E specifications.

Although the model of union growth developed in this paper provides a reasonably good explanation of the historical pattern of aggregate union membership growth in Canada, there are several limitations to our analysis. First and foremost, our model, like other similar econometric investigations, uses a single behavioural equation relating variations in union membership growth with various causal economic, social, legal, institutional and demographic factors. Questions have been raised whether the phenomenon of union growth can be captured in a single behavioural equation without resort to an ad hoc explanation or whether the formal modelling of the progress of an institution such as the labour movement is «particularly insightful or helpful»[27]. We are of the opinion that this approach, emphasizing measurement and quantification to give clarity to vague hypotheses, has contributed greatly to the settling of controversy over the key empirical determinants of union growth and is useful for studying the historical pattern of growth. However, this exercise may not be satisfactory for predicting future union growth where more general models may have an advantage over ad hoc explanations.

The predictive ability of our model and the reliability of its estimates is also subject to errors of measurement in data series and possible inappropriate specification of variables. While we have taken every possible care to use the best data available, measurement errors are possible due to imperfections in information gathering (e.g. trade union membership), and changes over time in methodology of data collection (e.g. changing weights in the Consumer Price Index or revisions in labour force survey data). The likelihood of error is greater where historical series are constructed by linking two series of data, for example the wage series and the non-agricultural paid worker series. Similarly the dummy variable specification of some union growth factors (e.g. the legislative framework established by PC 1003 in 1944 or the stock of grievances) may not be a valid indicator of the effects of these factors on Canadian union growth[28]. Indeed the large estimate of

27 See DUNLOP (1978, p. 6, n. 10).

28 See for example GREGORY and McALEER (1978) who apply transitional phase polynomials to a model of union growth in Canada to capture the effects of a gradual structural change on account of PC 1003.

the $D44_t$ coefficient does seem implausible and raises doubt about the appropriateness of the dummy specification. A third limitation of the model relates to its general validity. The model has been estimated for the period 1935-1981. Although we are confident that the broad relationships are valid generally, the precise details and forms of relationships may not apply to the pre-1935 years. We were unable to test the model for the early twentieth century because of the lack of proper data. Finally, our model, like other studies of this nature, is only concerned with key external factors in union growth, omitting others such as the union leadership or the union organization resources which either can not be easily quantified or have a sporadic and indirect effect on union growth.

To understand fully «why» and «how» unions grow, further research is required using various measures of union activity (e.g. certification and decertification of bargaining units, degree of union organization) and a more thorough analysis of both external and internal environmental factors in union growth. While there has been extensive research relating union growth to changes in the external economic, social, institutional and legal environment, much work remains to be done on the importance of such hard to quantify factors as trade union leadership, the structure of labour organizations, organizational resources, approaches, philosophies etc., as well as the management behaviour and human resource strategies. A more clear understanding of these external and internal environmental factors in our view can be gained better by micro-level research, that is by studying the behaviour and growth of individual unions; analyzing why individual workers join unions and what members expect from their unions and leaders; or by exploring the profile of union behaviour and collective bargaining relationship in individual sectors and industries.

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Analyse économétrique du développement des effectifs syndicaux au Canada, 1935-1981

Cet article étudie les déterminants empiriques principaux du développement global des effectifs syndicaux au Canada. Les auteurs proposent un modèle de la progression des syndicats fondé sur le dynamisme des modèles bien connus d'Ashenfelter et Pencavel (A/P (1969)) et de Bain et Elsheikh (B/E (1967a)) et ont incorporé à ce modèle plusieurs hypothèses rattachant la croissance des syndicats aux indicateurs économiques, à l'état de la législation et aux changements de la composition de la main-d'oeuvre. La valeur expérimentale du modèle est établie par une régression des moindres carrés ordinaires sur le taux de changement de la croissance globale des syndicats au cours de la période 1935-1981. La capacité de prévision et la stabilité dans le temps du modèle sont comparées et mises en opposition avec les calculs des modèles A/P et B/E. L'équation d'appréciation relie le développement des effectifs syndicaux à des changements linéaires et non-linéaires dans les prix, à la croissance décalée de l'emploi, aux changements dans le chômage durant les périodes d'expansion ou de contraction cycliques, au pourcentage de changement dans les salaires réels, au taux de syndicalisation, au taux de changement dans les effectifs syndicaux aux États-Unis ajusté au ratio des effectifs canadiens des syndicats proprement canadiens, à une mesure de l'impact de la structure de la législation en faveur du recrutement syndical introduit dans le CP-1003 et aux modifications dans le ratio de l'emploi dans les industries de biens et de services et dans le ratio de l'emploi des hommes et des femmes.

Les calculs empiriques du modèle montrent que le modèle proposé, en combinant les variables clés des modèles A/P et B/E et en les ajustant au changement structurel et aux variables politiques importantes pour le mouvement syndical canadien, offre une meilleure explication et des évaluations plus précises des principaux facteurs économiques et non-économiques qui ont modelé le développement des effectifs syndicaux au Canada. L'équation est capable d'expliquer presque quatre-vingt-dix pour cent de la variation dans la croissance globale des effectifs syndicaux au Canada pendant la période 1935-1981. Presque tous les paramètres de régression sont évalués à un haut degré de précision et le modèle est moins instable que les spécifications A/P et B/E.

Selon le modèle vérifié dans cet article, le type historique de développement syndical au Canada peut s'expliquer par une association de trois groupes de facteurs: 1) des facteurs de stabilité économique tels que l'inflation, le chômage, l'augmentation des salaires réels et la croissance décalée de l'emploi; 2) d'une politique gouvernementale, c'est-à-dire du cadre de l'organisation syndicale et de la négociation collective et 3) des facteurs structurels comme l'étendue de la syndicalisation actuelle et les changements dans la répartition démographique et industrielle de la main-d'oeuvre. Les calculs sous-entendent que le rapport entre le développement du syndicalisme et les divers facteurs économiques et non-économiques est à la fois linéaire et non-linéaire aussi bien que asymétrique et interrelié, ce qui reflète le caractère dynamique du processus de développement des syndicats. Par exemple, les effets de l'inflation sont non-linéaires, c'est-à-dire que le développement syndical est posi-

tif à de bas taux d'inflation, mais qu'il ralentit en périodes de forte inflation. De même, bien que le rapport général entre la croissance syndicale et les changements dans le chômage soit inverse, les tendances du chômage en regard du cycle économique ont un effet différent sur l'effectif syndical. Les calculs semblent indiquer que l'augmentation du chômage influence la croissance du syndicalisme d'une façon davantage défavorable pendant une période d'expansion économique que de récession économique. Les résultats sous-entendent aussi que la mise en vigueur de l'arrêté ministériel CP 1003 en 1944 a eu un double effet sur le recrutement syndical; non seulement l'arrêté ministériel a-t-il eu un impact positif sur le développement des syndicats, mais il a également fait monter le point de saturation relié au niveau de syndicalisation existant. Les calculs indiquent aussi que 1) les modifications dans l'emploi démographique et industriel, en augmentant la proportion des travailleurs traditionnellement «difficiles à syndiquer», ont eu un effet de ralentissement sur les effectifs syndicaux et 2) que le rythme du recrutement syndical aux États-Unis influence encore la syndicalisation au Canada malgré le déclin constant de la proportion des effectifs syndicaux rattachés aux syndicats américains.

Bien que le modèle alternatif du développement du syndicalisme fournisse une explication relativement bonne de la croissance historique des effectifs syndicaux au Canada, cette étude comporte plusieurs restrictions. D'abord et au tout premier rang, le modèle, comme toutes les autres investigations économétriques semblables, utilise une seule équation rattachant les variations dans le développement du syndicalisme aux différents facteurs causals d'ordre économique, social, juridique, institutionnel et démographique. On a soulevé la question de savoir si le phénomène de la croissance des effectifs syndicaux peut être appréhendé dans une seule équation sans recourir à une explication particulière afin de savoir si la nature formelle du progrès d'une institution comme le mouvement ouvrier est «particulièrement valable et utile». Les auteurs croient que l'approche économétrique, qui s'appuie sur la mesure et la quantification, pour éclairer des hypothèses vagues, a beaucoup contribué à la solution de la controverse au sujet des déterminants de la croissance du syndicalisme et est utile pour l'étude du modèle historique de la croissance. Cependant, il se peut qu'elle ne soit pas satisfaisante pour prédire le développement futur des syndicats là où des modèles plus généraux peuvent avoir un avantage sur les explications particulières.

La valeur prévisionnelle du modèle et la véracité de ses calculs sont aussi sujettes à des erreurs de mesure dans les séries statistiques et à une possible spécification peu appropriée des variables. La probabilité d'erreurs de mesure est plus grande là où les séries historiques sont constituées par la liaison de deux séries de données, par exemple, les séries de salaires et les séries de salariés non-agricoles. De même, l'appréciation plutôt lâche du coefficient de la variable relative à la législation semble peu plausible et soulève des doutes au sujet de la justesse du modèle des variables se rapportant aux questions politiques. Finalement, le modèle, comme les autres études de cette nature, ne traite que des facteurs clés externes de la croissance du syndicalisme, négligeant des facteurs comme le militantisme syndical, les ressources syndicales et le comportement et les stratégies des employeurs. Pour comprendre le «pourquoi» et le «comment» du développement du syndicalisme, il faudra de plus amples recherches qui aient recours à diverses mesures de l'activité syndicale et à une analyse plus approfondie des facteurs ambiants tant externes qu'internes de la croissance du syndicalisme.