The Determinants of Trade Union Growth in the Republic of Ireland: An Econometric Investigation

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Abstract: This paper documents an econometric investigation into the determinants of the rate of growth of trade union membership in the Irish economy. Empirical results obtained for the period 1943 to 1977 provide support for a number of the hypotheses of the Bain and Elsheikh (1976) model. In addition, the paper explores a number of further hypotheses, some of which relate to the particular institutional characteristics of the Irish labour market.

I INTRODUCTION

Between 1943 and 1977 trade union membership in the Republic of Ireland more than trebled: rising from 139.6 thousand to 426.6 thousand. The annual percentage rate of growth of union membership fluctuated widely over the period, ranging from a minimum value in 1971, when membership fell by 2.56 per cent, to its maximum value of 14.89 per cent growth

in 1947. Over the period as a whole, the annual growth rate in union membership displayed a standard deviation of 4.25 about its mean value of 3.27 per cent. This paper reports an investigation into the factors which determine the rate of growth of trade union membership in the Irish economy.

In a series of publications Bain and Elsheikh (see, in particular, their 1976 study) have examined the determinants of the rate of growth of aggregate trade union membership in Australia, Sweden, the United Kingdom and the United States and found some encouraging empirical support for a simple econometric model of the union growth process.[1] In this paper we use their model in an analysis of trade union growth in the Republic of Ireland. While the Bain and Elsheikh model is not without its critics (see, in particular, Richardson, 1977, 1978 and the response by Elsheikh and Bain, 1978), it nevertheless provides a convenient starting point for this, the first analysis of the Irish experience.

The paper is organised as follows: in Section II, the principal hypotheses of the Bain and Elsheikh model are briefly summarised and in Section III, the results obtained by estimating the model against Irish data covering the period 1943 to 1977 are presented and discussed. In Section IV, a number of additional hypotheses, some relating to the particular institutional characteristics of the Irish labour market, are tested and in Section V, the structural stability of the estimated model is investigated. In the final section, the main findings of the paper are summarised.

II PRINCIPAL HYPOTHESES TO BE TESTED

The dependent variable whose variation Bain and Elsheikh seek to explain is the annual proportional rate of change of trade union membership (which we denote by Δ T) and there are four principal hypotheses in their model. These concern, respectively, the influence on union growth of the following variables: the rates of price and money wage inflation, unemployment (and/or its rate of change) and union density (defined in the usual way as the ratio of actual to potential union membership).

In their analysis, Bain and Elsheikh see changes in trade union membership as being determined by changes in both the propensity and opportunity to unionise and on the basis of the reasoning sketched out below, they suggest that the dependent variable is expected to be *positively* related to the rates of change of retail prices and wages and *negatively* related to both

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1. See also Bain and Elsheikh (1982) for a disaggregated study of UK union growth. For a detailed survey of the US literature see Fiorito and Greer (1982) and for a recent reconsideration of the UK evidence see Booth (1983).

union density and the level and/or rate of change of unemployment.[2]

Bain and Elsheikh argue that workers are more likely to enter and to seek to remain in trade union membership during periods of rapid price inflation as they attempt to achieve money wage improvements of sufficient magnitude to protect their real standard of living from being eroded by rising prices. This they term a "threat effect". In addition, they suggest that if price rises are seen as an index of the general "prosperity of industry" they may also influence the opportunity to unionise. Employers may be more willing to concede demands for improvements in wages and other conditions of work during periods of rising prices partly because the opportunities for passing on increased costs may be more favourable and partly because they may fear the disruption of profitable production by industrial action in the cause of furthering unionisation. This is referred to as a "prosperity effect". Both threat and prosperity effects work in the same direction and suggest a positive relationship between ΔT and the rate of price inflation.

They also suggest that workers are more likely to join and remain in unions during periods when money wages are rising rapidly, as during such periods they tend to credit increased money wages to unions and hope that by joining or remaining with them they will do at least as well in the future. This they term the "credit effect".

It is also argued that union growth can be expected to be negatively related to union density, primarily because of the presence of a "saturation effect" which arises because the higher is density, the greater will be the difficulties of increasing membership further since there will be fewer workers left to recruit and because those who remain are likely to have a lower propensity and/or ability to unionise.

Lastly, it is suggested that membership can be expected to grow more slowly, or to fall, when unemployment is high or rising because the opportunities for extending union membership are less favourable during such periods. There are several lines of reasoning giving rise to this hypothesis. Bain and Elsheikh argue that given the low level of aggregate demand prevailing at such times, employers are more able to resist the spread of unionism as the (opportunity) costs in terms of forgone output resulting from disruptions of production in the cause of extending unionism tend to be lower. From the employees' viewpoint, it is also suggested that unemployment influences the propensity of workers to become and remain union members via its effects on the expected benefits of membership relative to its costs. Those becoming unemployed tend to withdraw from the union (possibly after some time lag, as many

2. In this paper we present only a brief summary of the Bain and Elsheikh model: for a more complete specification the reader should consult Bain and Elsheikh (1976, pp. 58-70). For an alternative approach which emphasises the relative costs and benefits of trade union membership see Ashenfelter and Pencavel (1969).

unions permit members to be in arrears for a number of months before withdrawing their membership) as they may feel that, being unemployed, membership has little benefit to offer them and, in addition, as member-ship costs typically rise in relation to their incomes. Some employed workers may also become reluctant to join unions during periods of high unemploy-ment for fear of antagonising their employers to the extent of losing their job in a period of excess labour supply. Furthermore, it is also argued that employed members may also tend to withdraw from membership during periods of high and rising unemployment as they estimate that under prevail-ing economic conditions the scope for union-won collective-bargaining advances is limited, to the extent that the expected benefits from member-ship (in the form of union-won improvements in wages and conditions of work) are no longer sufficient to outweigh membership costs.

On the basis of the above we can, by following Bain and Elsheikh in assuming linearity and specifying the density variable with a one period lag, in order to avoid the introduction of a spurious correlation between it and the dependent variable (Bain and Elsheikh, 1976, p. 70), write the basic estimating equation of the models as

$$\Delta T_t = a_1 + a_2 \, \Delta P_t + a_3 \Delta W_t + a_4 U_t + a_5 D_{t-1} + u_t \qquad (1)$$

where subscripts denote time and where

ΔT = the annual proportional rate of change of trade union mem-
    bership

ΔP = rate of price inflation

ΔW = rate of wage inflation

U = the level (and/or the rate of change) of the unemployment rate

D = union density

u = a disturbance term

On the basis of the above *a priori* arguments, the expected signs of the coefficients are as follows:

$a_2, a_3 > O$ and $a_4, a_5 < O$

III EMPIRICAL RESULTS

Table 1 summarises the results that were obtained by estimating Model (1) by ordinary least squares regression against annual Irish data spanning the period 1943 to 1977. (Full details of data sources and definitions are given in the Data Appendix.)[3]

3. Notice that since our membership data are based in large part on returns made to the Registrar of Friendly Societies they may, to the extent that some unions may fail to file returns in some years, be subject to some degree of measurement error.

Equation (1.1) corresponds to the basic equation of the Bain and Elsheikh model (Equation 1 above) and as can be seen these empirical results provide some degree of support for their model. The wage inflation and union density terms are each correctly signed and significantly different from zero at the 1 per cent level. Although incorrectly signed, the unemployment term is not significantly different from zero.

One interesting feature of the results reported in Equation (1.1) refers to the estimated coefficient of the price inflation term. This coefficient is wrongly signed *and* significant at the 1 per cent level. As we will see below, this result of a *negative* and highly significant relationship between union growth and the rate of price inflation emerges in each of our estimated equations. An interpretation of this result is offered later in this section.

In terms of its overall performance, Equation (1.1) is able to explain over 60 per cent of the variation of Irish trade union growth over the study period and the computed Durbin-Watson statistic provides no evidence of first-order serial correlation.

The possible existence of a lag between becoming unemployed and withdrawing from union membership (through unions tending to allow their unemployed members to go into arrears for some period) has already been noted and in an attempt to capture this effect, Equation (1.1) was re-estimated with a one period lag specified on the unemployment term but the results (Equation 1.2) remained virtually unchanged. Inclusion of a two period lagged unemployment term (Equation 1.3) also had virtually no influence on the results.

Bain and Elsheikh argue that *either* the level *and/or* the rate of change of the unemployment rate might influence the dependent variable and in order to test whether an unemployment change rather than level variable should be specified as an explanatory variable, it is necessary to test whether the estimated coefficient of the level of the unemployment rate is significantly different from minus one times that of its own lagged value. The appropriate econometric procedure here is to test the restriction that the coefficients of these two variables sum to zero. Application of the standard 't' test of this linear restriction (see Johnston, 1972, pp. 155-156) to Equation (1.3) fails to reject the null-hypothesis that the true coefficients are equal and opposite. However, since neither individual coefficient is significantly different from zero, this result implies that the lagged first difference of the unemployment rate enters with a zero coefficient, i.e., that it is not a significant determinant of union growth. The same finding emerged when this procedure was repeated with respect to the current and one period lagged unemployment rate, implying the non-significance of the (unlagged) first difference of the unemployment rate as an explanatory variable. These findings are borne out by Equations (1.4) and (1.5) which explicitly include,

Table 1: *Determinants of union growth in the Republic of Ireland, 1943-1977*

Equation Number	Intercept	ΔP_t	ΔW_t	D_{t-1}	U_t	U_{t-1}	U_{t-2}	ΔU_t	$U_t - U_{t-1}$	D_{t-1}^{-1}	R^2	D W
1.1	17.257* (5.2624)	−0.73912* (3.3371)	0.53340* (3.8153)	−0.37748* (5.6082)	0.04227 (0.87991)						0.6246*	2.0045**
1.2	15.895* (4.5716)	−0.77765* (3.6585)	0.55609* (4.0189)	−0.36793* (5.5315)		0.06577 (1.3666)					0.6375*	2.0098**
1.3	15.612* (3.8118)	−0.77552* (3.5791)	0.55462* (3.9308)	−0.36537* (5.2063)		0.056596 (0.68136)	0.013674 (0.13670)				0.6377*	2.0010**
1.4	17.767* (5.835)	−0.62041* (3.2552)	0.55521* (3.9325)	−0.36596* (5.3681)				−0.03587 (0.97189)			0.6267*	1.8962**
1.5	17.817* (5.7619)	−0.62163* (3.2386)	0.55703* (3.8862)	−0.36775* (5.3581)					−0.06768 (0.78288)		0.6226*	1.8854**
1.6	18.504* (6.2807)	−0.63916* (3.3739)	0.53359* (3.8306)	−0.37754* (5.6296)							0.6149*	1.9095**
1.7	−9.7248* (3.7478)	−0.69731* (3.5498)	0.53331* (3.6704)							502.4* (5.1599)	0.581*	1.7727**

Heading spanning coefficient columns: *Estimated coefficients of*

Note: In this and subsequent tables, figures in parentheses are 't' values. An asterisk denotes a coefficient which is significantly different from zero at the 1% level and a double asterisk denotes the absence of first-order autocorrelation at the 5% level.

respectively, the proportionate and absolute rates of change of the un-employment rate. In both cases the unemployment change variable is cor-rectly signed but in neither case does it achieve significance. The absence of any relationship between unemployment and union growth in Ireland is perhaps somewhat surprising when one recognises that significant relations were found in each of the four countries studied by Bain and Elsheikh. A number of possible explanations are discussed in Sapsford (1984).

Equation (1.6) reports the estimates which were obtained when non-significant variables were excluded from the vector of independent variables and these provide a summary of our findings so far; showing that Bain and Elsheikh's basic model is able to explain over 60 per cent of the variation in Irish union growth over the period 1943-77. The wage inflation and density variables are both significant at the 1 per cent level and both signed in accordance with *a priori* expectations. The price inflation term is, however, incorrectly signed and significant at the 1 per cent level and there is no evi-dence of first-order autocorrelation.

In their discussions of the likely influence of density on union growth, Bain and Elsheikh (1976, pp. 68-77) acknowledge the possible non-linearity of the relationship between these two variables and go on to specify, for the UK, equations utilising density specified in reciprocal and quadratic forms. The regressions reported in Table 1 were re-estimated with density specified first in a reciprocal form and second in a quadratic form. In the former case, the overall configuration of results with respect to the signs and significance of the coefficients of the other explanatory variables remained unchanged, as did the orders of magnitude of both R^2 and Durbin-Watson values. How-ever, it should be noted that the results obtained with density specified in quadratic form were somewhat less supportive of the density effect, with density in a number of formulations failing to exert a significant effect on union growth. Equation (1.7) includes density in reciprocal form and is pre-sented as being representative of the results obtained with a non-linear density variable. Judging the three alternative density formulations accord-ing to their contribution to the overall explanatory power of the model, the quadratic form is markedly inferior to both the linear and reciprocal forms. Comparing Equations (1.6) and (1.7) we see that the linear formulation gives rise to slightly more satisfactory values of *both* R^2 and Durbin-Watson statistics and for this reason is to be preferred.

Price Inflation, Real Wages and Union Growth

As already noted, one feature of our results is the negative (contrary to Bain and Elsheikh's hypothesis) and significant effect of price inflation on

Irish union growth[4] and in order to offer an interpretation of this result we follow the spirit of Bain and Elsheikh's own analysis by explicitly recognising the two-sided (worker and employer) nature of the unionisation process. One possible interpretation of the observed negative relation is that over the study period the propensity of workers to unionise increased with price inflation in the fashion hypothesised by Bain and Elsheikh *but* that at the same time, the resistance of employers to the further spread of unionisation increased to such an extent that it more than offset the increase in workers' propensity to unionise. The analytical parallels here between the two-party nature of the union growth process and that of strike activity have been clearly stated by Richardson (1977, p. 280) and a formal treatment of this sort of issue in the latter context is given by Sapsford (1978).

In the Irish context there are perhaps good reasons to expect the existence of a positive relation between employer resistance to the spread of unionisation and the rate of price inflation rather than the negative association implied by Bain and Elsheikh in their discussion of the "prosperity effect" outlined above. One important characteristic of the Irish economy is its high degree of inter-relatedness with that of the UK (see, for example, Kennedy and Bruton, 1975) with around 50 per cent of Ireland's trade over the study period being with the UK. This, taken together with the very pronounced tendency for the Irish rate of price inflation to exceed that of its main trading partner, the UK, suggests that it is perhaps reasonable to argue that during periods of rapid price inflation Irish employers, fearing the likely increased costs associated with conceding further improvements in wages and other conditions of employment (with the consequent further erosion of their competitive position *vis-à-vis* the UK as its main trading partner) tended to strongly resist the further spread of unionisation.[5]

In summary, one possible interpretation of the observed negative association between price inflation and Irish union growth is that it represents the outcome of a process in which the resistance of employers to the spread of unionisation increased in response to competitive considerations during periods of rising price inflation to such an extent that it more than offset

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4. The potential problem of multicollinearity between the wage and price terms has been widely recognised in the literature (e.g. Bain and Elsheikh, 1976). However, re-estimation of the model with several observations deleted, with the ΔW term excluded, with a lagged price inflation term substituted for the current one and in Bain and Elsheikh's (1976, p. 77) real-wage form (proposed by them as a device for handling wage-price collinearity) provided no evidence to suggest that the perverse sign on the price inflation term is a reflection of multicollinearity problems between the wage and price inflation terms.

5. Notice that evidence suggests the existence in Ireland of a union/non-union earnings differentials to the order of 16 per cent (Walsh and Whelan, 1976, p. 210).

any tendency there was for the unionisation propensity of workers to increase during such periods.[6]

Inspection of the estimated coefficients of the rates of wage and price inflation reported in Table 1 show their absolute values to be quite close. If the estimated coefficient of the rate of wage inflation were found to be not significantly different from minus one times that of the rate of price inflation, then this would clearly imply that the model be re-specified with the rate of change of real wages replacing the separate wage and price inflation terms.[7] However, for each of the equations reported in Table 1 we are led to reject at the 5 per cent level the restriction that the parameters of the wage and price inflation terms sum to zero. For example, application of the usual F test for this linear restriction to Equation (1.6) yields an F ratio of 14.568 with (1,31) degrees of freedom and since the tabulated value of F with these degrees of freedom at the 5 per cent level is approximately 4.1 we are led to reject the null hypothesis that the coefficients of the price and wage inflation are equal and opposite.

Estimation Problems

There is something of a debate in the union growth literature (see, for example, Bain and Elsheikh 1976, pp. 117-118, Elsheikh and Bain 1978, pp. 99-100 and Richardson 1977, p. 280 and 1978, p. 104) regarding the appropriate method of estimating the parameters of union growth functions. The results so far reported in this paper, like those reported by Bain and Elsheikh, have all been obtained by ordinary least square regression. Possible simultaneity problems arise because ΔW and ΔP might themselves be influenced by, while also influencing, ΔT. The possibility that a relationship exists between ΔT and ΔW is a well known one in the wage inflation literature (see, in particular, Hines, 1964, 1968, 1969) and has been much discussed, criticised and defended since the publication of Hines's well known paper in 1964 (see, in particular, Purdy and Zis, 1974 and Dogas and Hines, 1975) and the possible influence on ΔP then follows via the usual sort of price equation.

6. Some preliminary investigations using as explanatory variables measures of Ireland's inflation rate relative to the UK's suggest that relative inflation may have exerted a significant influence on Irish union growth.

7. As can be seen from Table 1, our results would, if this restriction were found to hold, imply the existence of a *positive* relation between real wage changes and union growth. Interestingly in the specification of an alternative model designed to explain union growth in Australia, Sharpe (1971) hypothesised and found support for the existence of a *negative* relation between (some distributed lag of) real wage changes and union growth; his argument being that worker discontent and hence the desire to unionise in order to protect real wages, is likely to increase when real wage growth declines. For detailed discussion of this model, see Bain and Elsheikh, (1976, pp. 45-55).

To guard against possible simultaneity problems a variety of experiments were conducted in which the Bain and Elsheikh model of union growth was set in a simultaneous equation framework. Although the specification and estimation of a full simultaneous equation model of the wage-price-union growth system is outside the scope of the present paper, our experiments with the specification and inclusion of a variety of plausible wage and price equations (including those specified by Hines, 1964 and Ashenfelter, Johnson and Pencavel, 1972)[8] provided no evidence of simultaneous equation bias. In fact, the estimates of the parameters of the union growth function which were obtained by appropriate simultaneous equation estimation techniques proved to be of virtually unchanged magnitude and unchanged in respect of their significance. In view of these findings we follow Bain and Elsheikh in the remainder of this paper and employ ordinary least squares as our method of estimation.[9]

Some Additional Hypotheses

One additional hypothesis which has recently been tested against UK data concerns the relationship between union growth and profits (Burkitt and Bowers, 1978). The argument here, which is in the spirit of Kaldor (1959), is that workers are more likely to join unions during periods of high or rising profits because they judge that the scope for union-won gains is increased during such periods. Evidence in support of this hypothesis was found by Burkitt and Bowers (1978) in a study of UK data covering the period 1924 to 1966. The validity of this study has been challenged on a variety of grounds by Elsheikh and Bain (1979) and as far as the role of profits is concerned, they argue that the above hypothesis is unsatisfactory because of its "indirect nature" (1979, p. 452). However, Elsheikh and Bain concede that there may be a role for profits as an additional explanatory variable in that they may prove to be a more satisfactory proxy than the rate of price inflation for the general prosperity of industry and therefore prove more able to capture the so called "prosperity effect" referred to above. Whether one subscribes to either the Burkitt and Bowers or Bain and Elsheikh view of the role of profits, it is important to notice that Bain and Elsheikh's re-estimations of their own model for the UK did show that the inclusion of a profit variable resulted in a significant improvement in their model's explanatory power.

8. Notice that Cowling's (1966) study of the determinants of wage inflation in Ireland between 1949 and 1963 found little support for the Hines model.

9. A number of interesting econometric issues arise in the analysis of disaggregated (particularly individual) data relating to union membership. See, in particular, Schmidt and Strauss (1976), Olsen (1978), Schmidt (1978) and Lee (1978).

Accordingly, the equations reported in Table 1 were re-estimated with profits included as an additional explanatory variable: the expected sign on the profits term being positive. The results thus obtained are summarised in Table 2. Equations $(2.1) - (2.4)$ report the results which were obtained by adding a profits term to Equations (1.6) and (1.7). Equations (2.1) and (2.2) report, respectively, the results obtained by the addition of gross profits (π) and real profits $(\frac{\pi}{P})$ to specification (1.6). In both cases the estimated coefficient of the profit term is positive (in accordance with expectations) and significantly different from zero at the 1 per cent level. In neither equation is there any evidence of serial correlation but in terms of goodness of fit, Equation (2.2) (the real profits version) is to be marginally preferred. Equations (2.3) and (2.4) correspond to (1.7) above and report the results which were obtained with density specified in its reciprocal form. In both cases, the profit coefficient is correctly signed and significant (at the 5 and 1 per cent levels, respectively) although the Durbin-Watson statistic for Equation (2.4) falls just inside the indeterminate range at the 5 per cent level. In terms of overall performance as judged by both R^2 and Durbin-Watson criterion, Equation (2.2), which uses density in its linear form together with real profits, is to be marginally preferred.[10]

In their study of the US experience, Ashenfelter and Pencavel (1969, p. 439) specify as an explanatory variable the proportion of Democrats in the US House of Representatives. The logic of this variable is to proxy pro-labour sentiments, which they argue influence both workers' responses to union recruitment activities and the amount of legislation conducive to union growth. Empirical analysis of the US data between 1904 and 1960 shows the coefficient of this variable to have the expected positive sign and to be significantly different from zero.

Arguably the nearest things to labour (type) governments experienced in the Republic of Ireland during the study period were a number of coalitions which included Labour Party representatives. In an attempt to test whether similar political factors might have exerted a significant influence on Irish union growth we specified as an additional explanatory variable, a dummy variable (denoted by POL), taking the value of unity when a coalition was in power and zero otherwise.

The results that were obtained when this dummy variable was added to specification (2.1) are set out in Equation (2.5) from which it is seen that the

10. These equations were re-estimated with the various unemployment variables considered above in the context of Table 1 included as explanatory variables but once again unemployment in each and every case failed to achieve significance. In addition, it should be noted that the nominal profits version is also less satisfactory since it implies the existence of an arguably implausibly high degree of money illusion on the part of unions.

Table 2: *Determinants of Union Growth in the Republic of Ireland, 1943-77: Further Analysis*

Equation Number	Intercept	ΔP_t	ΔW_t	D_{t-1}	D_{t-1}^{-1}	π_t	$\left(\dfrac{\pi}{P}\right)_t$	POL_t	R^2	DW
2.1	21.334* (7.2164)	−0.85764* (4.3705)	0.48994* (3.7642)	−0.43664* (6.5662)		0.012758* (2.4827)			0.6805*	2.0687**
2.2	22.000* (7.7688)	−0.78632* (4.5249)	0.36572* (2.7248)	−0.51018* (7.0020)			34.117* (3.1243)		0.7094*	1.9104**
2.3	−11.263* (4.4219)	−0.91014* (4.3501)	0.49250* (3.5593)		578.03* (5.8900)	0.11952 (2.1936)			0.6389*	1.8864**
2.4	−15.492* (4.7280)	−0.84485* (4.4545)	0.38499* (2.6435)		662.03* (6.0725)		30.170* (2.5703)		0.6566*	1.7042
2.5	21.340* (6.9649)	−0.85754* (4.2918)	0.48982* (3.6855)	−0.43673* (6.4183)		0.12776 (2.3318)		−0.010947 (0.010791)	0.6805*	2.0677**

political variable is incorrectly signed and not significantly different from zero. Repetition with the political dummy added to specifications (2.2) to (2.4) also showed its estimated coefficient to be not significantly different from zero. In summary, our results present no evidence to suggest that political (in the Ashenfelter and Pencavel sense) factors exerted any significant influence on the rate of union growth in post-war Ireland.[11]

Finally, Bain and Elsheikh present some evidence to suggest that for the UK, the relation between the rate of price inflation and union growth is non-linear, with the positive influence of price inflation on union growth apparently occurring at a lower rate when the rate of price inflation equals or exceeds 4 per cent per annum (Bain and Elsheikh, 1976, p. 70). This is indeed a surprising result when one recognises that evidence in the inflationary expectations literature (see, in particular Carlson and Parkin, 1975) suggests that the degree of perception of inflation *increases* as the inflation rate increases. Given that the argument underlying Bain and Elsheikh's inclusion of a price inflation term is, in large part, specified in terms of the threat effect on workers' living standards posed by price inflation, it is perhaps reasonable in the light of the above evidence regarding the perception of inflation to expect the slope of the (partial) relation between price infla-

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11. One particular characteristic of the wage determination process in post-war Ireland has been the existence of a series of highly centralised wage bargains known as National Wage Agreements (for a detailed description of these see O'Brien, 1981). It is perhaps reasonable to expect that the rate of union growth in Ireland might have been influenced by the existence of these agreements, with one possible line of reasoning being that during periods when National Wage Agreements were in operation, the credit effect referred to above was strengthened as workers became more aware of the wage bargaining activities and achievements of unions. In order to test this hypothesis we specified as an additional explanatory variable a dummy variable (denoted by NWA_t) which took a value of unity during periods when an Agreement was in operation and zero otherwise.

Equation (i) below summarises some of the results which were obtained and as can be seen from this equation (which, apart from the profits variable, corresponds directly to Equation (1.3) in Table 1 above and to equation 5 in Bain and Elsheikh's (1976, p. 72) own analysis of the UK) the NWA coefficient is incorrectly signed and not significantly different from zero.

$$\Delta T_t = 30.994^* - 0.80429^* \Delta P_t + 0.4052^* \Delta W_t - 0.10485 \, U_{t-1}$$
$$(4.2588)(3.939)(2.747)(0.98821)$$

$$-0.049309 \, U_{t-2} - 0.53229^* D_{t-1} + 0.02705^* \, \pi_t - 0.37621 \, NWA_t$$
$$(0.48711)(5.66721)(2.4848)(0.31454)$$

$$R^2 = 0.7052^*, DW = 2.0904^{**}$$

(* denotes significance at 1% level, ** denotes absence of auto-correlation at the 1% level).

Re-estimation of each of the equations set out in Table 2 with the inclusion of the variable NWA_t confirms this finding; with the estimated coefficient of NWA_t failing to achieve significance in any equation.

tion and union growth to *increase* rather than decrease as price inflation exceeds some threshold level and workers become more acutely aware of the effect of inflation on their living standards. This point is not, however, discussed by Bain and Elsheikh.

In order to test for the possible existence of a non-linearity in the relationship between price inflation and union growth we followed Bain and Elsheikh's methodology and employed slope dummies on the price inflation term. The equations reported in Table 2 were re-estimated with slope dummies (denoted by S) specified on the price inflation term, defined so that these become operational when price inflation exceeded some specified level.[12] This "threshold level" for the operation of the slope dummies was increased from 2 to 12 per cent per annum and in each case the estimated coefficient of the slope dummy was found to be positive but in no case did we find the existence of a significant coefficient. In other words, our findings provide no evidence of the existence of a non-linearity in the relationship between price inflation and union growth in Ireland.[13]

12. These slope dummies were defined in the usual way as

$$S_t = \Delta P_t . I_t$$

where I_t is an intercept dummy defined such that

I_t = 1 when $\Delta P_t > \alpha$ per cent per annum

I_t = 0 otherwise

and α = specified threshold level of the annual price inflation rate

where $2 \leqslant \alpha \leqslant 12$ and α is an integer.

13. Equations (i) and (ii) below report, for illustrative purposes, some results that were obtained with the threshold for the operation of the slope dummy set at 4 and 12 per cent per annum respectively. These equations correspond directly to Equation (1.3) in Table 1 (above) and to Equation 6 in Bain and Elsheikh's (1976, p. 72) analysis of the UK.

Equation (i) (*Threshold for Price Inflation Slope Dummy Variable = 4 per cent per annum*)

$$\Delta T_t = 15.52^* - 1.1166^* \Delta P_t + 0.53991^* \Delta W_t + 0.052264 U_{t-1}$$
$$(3.7626) \quad (3.7626) \quad (3.7684) \quad (0.62367)$$

$$+0.014373 U_{t-2} - 0.35113^* D_{t-1} + 0.33265 S_t,$$
$$(0.14273) \quad (4.8135) \quad (0.78438)$$

$$R^2 = 0.64559^*, DW = 1.9952^{**}$$

Equation (ii) (*Threshold = 12 per cent per annum*)

$$\Delta T_t = 15.911^* - 0.84^* \Delta P_t + 0.53991^* \Delta W_t + 0.045249 U_{t-1}$$
$$(3.8545) \quad (3.6526) \quad (3.7153) \quad (0.53586)$$

$$+0.026137 U_{t-2} - 0.36447^* D_{t-1} + 0.13583 S_t,$$
$$(0.25755) \quad (5.1706) \quad (0.86681)$$

$$R^2 = 0.6472^*, DW = 1.9611^{**}$$

Structural Stability

The above analysis has so far considered the complete 1943 to 1977 period. The possibility that economic variables may be connected by relationships having the property that the parameters of the relations may be-subject to discontinuous change has been widely discussed in the recent econometric literature (for a survey see Goldfeld and Quandt, 1973) and in the context of the present analysis it is of interest to notice that Sheflin, Troy and Koeller (1981) have recently analysed the structural stability of both the Bain and Elsheikh and Ashenfelter and Johnson models, as applied to the US data, using these sort of techniques and found some evidence of structural instability in both models.

The problem of estimating the parameters of a system obeying two separate regimes has been considered within a regression framework by Quandt (1958) who devised a maximum likelihood method of estimating the location of the switch from the first to the second regime and we used this procedure in order to investigate the structural stability of the Bain and Elsheikh model as applied to Ireland over the period 1943-1977. Applying Quandt's maximum likelihood procedure to the various equations reported in Tables 1 and 2, we find, virtually without exception, that 1962 emerges as the maximum likelihood estimate of the date at which the switch between regimes occurred. Having estimated the location of the switching point, it was necessary to test whether a switch actually occurred during the period under study and following Goldfeld and Quandt's (1973) suggestion we employed the Chow (1960) test for this purpose. In no case did the results of Chow's F test lead us to reject the null-hypothesis that the post-1962 observations obeyed the same structural relation as the pre-1962 ones. In short, and in contrast to the finding of Sheflin *et al* (1981) for the USA, our analysis provides no evidence of structural instability in the Bain and Elsheikh model as applied to the Irish case.

IV SUMMARY AND CONCLUSIONS

In this paper we have tested the Bain and Elsheikh model of the determinants of trade union growth against post-war Irish data. Our results provide confirmation of their hypotheses regarding the influence on union growth of the rate of wage inflation and union density, but provide no evi-

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(*denotes significance at the 1 per cent level, ** denotes the absence of autocorrelation at the 5 per cent level).

This exercise was also repeated with an intercept as well as the (price inflation) slope dummy included, but in no case did either dummy achieve significance.

dence to suggest that either the level and/or rate of change of the unemployment rate influenced union growth. In addition, we found (contrary to the hypothesis of Bain and Elsheikh) the existence of a negative and significant relationship between the rate of price inflation and union growth. An interpretation of this finding, based on an explicit recognition of the high degree of inter-relatedness between the economies of Ireland and the UK, was offered.

A number of additional hypotheses were tested and of these, the only one to find support concerned the influence of profits, with our results showing that profits exerted a significant positive influence on union growth: a finding also evident in some previous work on the UK experience. Finally, the structural stability of the model was investigated using the switching regression model, the results of which provided no evidence of structural instability.

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DATA APPENDIX: SOURCES AND DEFINITIONS

Each rate of change variable was defined in the following way

$$\Delta X_t = \frac{X_t - X_{t-1}}{X_{t-1}}$$

Trade Union Membership (T)

Data on membership of unions in Ireland were obtained from the *Annual Reports of the Irish Registrar of Friendly Societies* (Dublin: various issues), to which were added data relating to membership of branches in the Republic of Ireland of UK registered unions, as published in the *Department of Employment Gazette* (HMSO, London: various issues).

Retail Prices (P)

This index was derived by linking together the Cost of Living Indices (1941-53) and the Consumer Price Index (1953-77). *Sources: Irish Trade Journal and Statistical Bulletin (ITJSB)* and *Irish Statistical Bulletin (ISB)*.

Wages (W)

This index refers to total weekly earnings per wage earner. Data for the period 1942-49 were obtained from the *ITJSB* and refer to "certain industries" which together account for approximately 80 per cent of employment in the production of transportable industrial goods. Data from 1950 onwards were obtained from *ISB* and refer to the results of the Quarterly Inquiries covering all transportable goods industries.

Unemployment (U)

These data refer to persons recorded as unemployed on the "Live Register" expressed as a percentage of the employed plus the unemployed and were obtained from *ITJSB* and *ISB*.

Union Density (D)

This is defined at T/E where E denotes the number of employees in non-agricultural employment plus those recorded as unemployed. Data on the number of employees for the period 1951-66 were obtained from Hughes, 1972, (Table A.6), while data for the period 1967-77 were obtained by up-dating and re-estimating Hughes' own data using 1971 Census results and

data presented in the 1978 and 1980 issues of *Economic Review and Outlook* (CSO, Dublin). There being no estimates of numbers at work in non-agricultural employment prior to 1951 (other than for the census years of 1936 and 1946) these data were estimated by the method described in Hughes (1972, Table A.6, Note 2).

Profits (π)

Data for the years 1944 to 1977 refer to the "Trading profits of companies (including corporate bodies) before tax" and were obtained from *ISB* and *National Income and Expenditure* (CSO Dublin). The 1943 figure was obtained as a predicted value from a linear regression of π on corporation tax returns (*Source: Reports of the Revenue Commissioners*, Dublin).