The Effect of Collective Bargaining on Earnings in Northern Ireland in 1973

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Abstract: This paper uses data from the New Earnings Survey to see if trade unions secure relatively higher wages for those workers covered by collectively bargained agreements. A standard econometric model is used, and our results indicate that a "wage-gap" of around 11 per cent for male workers and 19 per cent for female workers existed in 1973.

I INTRODUCTION

This paper makes use of unpublished New Earnings Survey (NES) data to consider an important topic in the field of labour economics, viz., do trade unions secure *relatively* higher levels of pay for those workers who are covered by collectively bargained agreements? Because of the nature of the NES, and because the 1973 survey asked for details about collective agreements in Northern Ireland, it is possible to obtain separate pay details for those individuals that were either "covered" or "not covered" by an agreement. Hence, we have been able to estimate the size of the "wage gap" that accrues to workers covered by collective agreements, using the approach developed by Lewis (1963) and a suitable database.

Our results indicate that collectively bargained wages would seem to have been approximately 11 per cent higher for male workers and 19 per cent higher for female workers in 1973, although there were different effects for various sub-groups within these categories of workers. However, before presenting the model and methods of estimation, Section II begins by separating "covered" and "not covered" workers in each industry and testing

for the presence of a statistically significant differential between the two groups. Thus, we shall be considering whether the effect of collective bargaining on any wage differential is apparent between groups of workers *within* any sector, before going on (in Section III) to include any effect between high and low coverage sectors.

Finally, it is worth noting that some workers covered by a collective agreement do not belong to trades unions (e.g., in 1974 61.7 per cent of male employees were members of trades unions, while in 1973 over 70 per cent of male employees were covered by collective agreements). Hence, the "wage-gap" that we seek to measure accrues to more than just those workers belonging to a union that negotiates upon their behalf.

II INTRA-GROUP EFFECT OF COLLECTIVE BARGAINING COVERAGE ON EARNINGS

We begin by separating "covered" and "non-covered" workers in each industry and testing for the presence of a statistically significant wage differential between the two groups. In theory, the data available for conducting such an exercise comprised some 2,500 full-time adult workers, whose pay was not affected by absence during any part of the pay period considered. Because of confidentiality restrictions, we had access to a specially compiled data-tape which aggregated workers into groups of between 3 and 5. The method of aggregation was based upon each worker having in common certain characteristics (e.g., all in the same industry group and occupation group, and most importantly for the present purposes, all covered/not covered by a collective agreement).[1] Hence, we have assumed that each observation (of 3-5 individuals) is sufficiently homogeneous to ensure that the test for a significant intra-industry differential is meaningful. Given the way the data were compiled for us, we believe that this objective has been largely achieved.

Before considering the results, it is important to stress two particular arguments as to why relatively few significant intra-industry differentials

1. As stated, each group of 3-5 individuals, that comprise an observation in our dataset, have certain common characteristics. Besides each observation being uniquely classified by sex, whether full-time or not, whether adult or juvenile, and whether pay was affected by absence or not, the criteria used to combine individuals mean that each observation is uniquely classified to one of 10 industry divisions (1980 SIC) sub-divided into 8 socio-economic occupations. Observations also contain workers that are either covered or not covered by collective agreements. The original NES data-tape was also sorted in advance of aggregation (into groups of 3-5 workers) by whether a worker received overtime pay, or incentive payments or shift premium payments. Hence, although these particular criteria have not been used to delineate the boundaries of each observation, nevertheless each observation will contain groups of workers that are expected to be homogeneous with respect to these characteristics.

are likely to be observed in practice. First, the existence of legislation that requires the payment of the going industry wage will minimise any pay differential between "covered" and "non-covered" workers within an industry. The Terms and Conditions of Employment Act 1963 (NI) and the 1947 Fair Wages Resolution of the House of Commons (NI) are examples of this legislative effect. The latter has only applied to public sector contracts, in that it obliges all contractors and their sub-contractors to ". . . pay rates of wages and observe hours and conditions of employment not less favourable than those established for the trade or industry in the district" (quoted from Steele, 1978). However, the public sector has tended to play such a wide role in the Northern Ireland economy, that the influence of this piece of legis- lation is unlikely to have been confined to only a very few sectors. Secondly, the "threat effect", whereby non-union employers seek to minimise any threat of unionisation among their employees by paying the relevant unionised rate, will be of relatively greater strength within individual industries as opposed to across industries. Hence, the benefits of collective bargaining are more likely to be spread to other workers within an industry, minimising the likelihood of any intra-group differential.

Table 1 shows those industries (and occupations for manual workers) which record significant wage differentials between "covered" and "non- covered" male workers. The figures present ratios of the order of magnitude of the "wage-gap" for those groups which had a significant differential. The figures in italics are comparable results for Great Britain. Overall, Table 1 shows that Northern Ireland generally experienced higher wage differentials, between "covered" and "non-covered" male workers, than did Great Britain,[2] although of the total number of differentials that could have featured (46), only 28 per cent had significant values in Northern Ireland (compared to over 36 per cent in Great Britain). Moreover, two important employment sectors (Distribution and Other Services) displayed a greater number of

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2. It is not an easy matter to account for the relatively larger intra-industry wage differentials in Northern Ireland. The effect of trades unions on the dispersion of earnings is likely to be of relevance since earnings' dispersion is lower among "covered" workers, because ". . . union activity simply trun- cates the distribution [of earnings] at a particular wage, in effect bringing all workers previously below a certain wage up to a minimum" (Metcalf, 1982). Hence, given that wages were relatively lower in Northern Ireland in 1973, the gap between covered and non-covered workers may be higher in the Province. This argument seems more plausible than one that relates the higher Northern Ireland dif- ferential to relative trade union densities, since these do not appear to be all that different across the two parts of the UK (see Black, 1986, Table 7, Chapter 2). Two other likely causes of the results obtained are also worth mentioning: first, "covered" workers in Northern Ireland may be of *relatively* higher quality, and are thus paid more than "not covered" workers. Secondly, the results for Great Britain are likely to be strongly influenced by wages and coverage levels existing in the South East region of GB (simply by size of population). The latter has generally higher levels of pay for almost every category of worker, and yet significantly lower levels of coverage by collective agreements (Beaumont and Harris, 1988). This should depress the "covered"/"not covered" differential for GB.

significant "wage-gaps" in Great Britain than in Northern Ireland. Finally, it is interesting to note that the private sector (both in Northern Ireland and Great Britain) was more likely to experience a significant "covered/not covered" differential, as the public sector presumably spreads the effects of collective bargaining to all its workers through higher coverage levels enhancing the "threat effect", but also because of a closer adherence to "fair-wage" legislation (cf. the discussion above).

Table 1: *Values of the Ratio of "Covered/Not Covered" Male Average Hourly Earnings on an Intra-Industry Basis in 1973, Northern Ireland and Great Britain*

Industry	Non-Manual	Foremen	Occupation Skilled Manual	Semi Skilled Manual	Unskilled Manual	Total Manual
Agriculture	na[1]	—	—	1.32**	—	1.15[+]
	na[1]					*1.03[+]*
Energy & Water	na	na	na	na	na	na
	*0.88**	*na*	*na*	*na*	*na*	*na*
Metals & Chemicals	—	—	1.32**	1.55**	—	
	*0.82**	*0.94**	*1.10**	*1.05**	*1.11**	
Engineering & Vehicles	0.75**	na	na	na	na	na
	*0.83**		*1.11**	*1.13**	*1.11**	*1.07**
Other Manufacturing	na[1]	—	1.18[+a]	1.22**		1.12[+]
	*0.91**		*1.05**	*1.06**		*1.04**
Construction		na		—	1.14*	1.16**
				*1.09**		
Distribution	na[1]	—		1.08*[a]		1.20[+a]
	*0.82**	*0.91**	*1.06**	*1.10**	*1.10**	*1.08**
Transport & Communications	—	—	na		na	1.13[+]
	*0.86**		*1.13**			*1.05**
Business Services	1.77**	—	—	—	—	—
	*0.87**		*0.88**			
Other Services		—			1.09[+a]	
	1.04[+]	*1.10**		*1.06**	*1.30**	*1.07**

Source: NES.

Notes to table: **significant at 1% level; *significant at 5% level; [+]significant at 10% level.
na   most (or all) workers covered by an agreement
na[1]   most (or all) workers not covered by an agreement
—   insufficient data for a comparison in Northern Ireland
      figures in italics refer to Great Britain
a   refers to a comparison based on average gross weekly pay

Turning to female workers, insufficient data (because of too few female full-time workers and a high degree of specialisation in certain industries) precludes a detailed analysis of intra-group differentials in most sectors. In fact, only Other Manufacturing and Other Services had significant differentials for female manual workers[3] (see Table 2). As for male workers, the differentials were relatively larger for Northern Ireland and relatively higher in Other Services in both Northern Ireland and Great Britain.

Table 2: *Values of the Ratio of "Covered/Not Covered" Female Average Hourly Earnings on an Intra-Industry Basis in 1973, Northern Ireland and Great Britain*

			Occupation		
Industry	*Foremen*	*Skilled Manual*	*Semi Skilled Manual*	*Unskilled Manual*	*Total Manual*
Other	—	—	1.16**	—	1.13*
Manufacturing		1.10**	1.06**	1.10**	1.06**
Other Services	—	—	1.41*	1.46*	1.36*
	1.21**	1.27**	1.26**	1.25**	1.24**

See Notes to Table 1.

In summary, although there were relatively fewer groups with significant intra-industry wage effects, these results suggest that, *overall*, collectively bargained wages were significantly higher than those paid to workers not covered by a collective agreement.

III   INTER-GROUP EFFECT OF COLLECTIVE BARGAINING COVERAGE ON EARNINGS

In this section we take account of the possibility that the effect of collective bargaining coverage on any wage differential might be stronger between high and low coverage sectors, rather than between groups of workers *within* any sector. This involves estimating a well known equation that seeks to measure

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3. These two account for 65 per cent of the NES female full-time adult sample. If distribution is added this figure rises to 81 per cent, but coverage levels in the latter sector were very low in 1973, resulting in no significant differential.

the "wage-gap",[4] while at the same time "controlling" for the various deter-
minants of intra-industry pay differences (e.g., labour quality differences)
as well as any inter-industry differences in, for example, firm size and profit-
ability (since these are likely to affect relative employee bargaining power —
see Kochan (1980), Chapter 10). The need to include the latter has been
stressed by Blanchflower (1986), in a review of previous attempts to measure
the "wage-gap" in Great Britain. He states that ". . . in the last few years
[previous] work has been subjected to a good deal of scrutiny . . . a serious
deficiency was that the set of explanatory variables used to control for labour
quality and workplace characteristics was very limited".

Following Lewis (1983), equations of the following form were estimated
at the level of the individual (see Appendix 2):

$$\ln W_{ij} = a + a_x X_{ij} + a_y Y_j + (a_u - a_n)U_{ij} \tag{1}$$

where i refers to the ith individual in the jth bargaining group; W is hourly
wages; X the vector of explanatory variables; Y is the "extent of coverage"
variable and refers to coverage by collective agreement in the jth bargaining
group; U is a dummy variable (0,1) indicating whether the individual is
covered by a collective agreement. As Lewis (op. cit.) points out, an unbiased
estimate of the "wage-gap" can be obtained from the value of the parameter
attached to the variable U in the equation, after converting back from
logarithms, *viz.* $100 [Exp(a_u - a_n) - 1]$. He also states that ". . . the presence
of the union status variable U on the right hand side of the wage equation is
critical for estimating the wage gap. In this connection, notice that the critical
variable is union status U, not extent of unionism y". Most of the previous
attempts to estimate the "wage-gap" in Britain have specified an equation
such as our Equation (1), but without including U (e.g., Layard, Metcalf
and Nickell, 1978).

The vector of explanatory variables X, included various dummy variables
in an attempt at capturing the intra-industry determinants of pay:[5]

4. Note that we are using data that refer to whether a worker was covered by a collective agree-
ment, and not whether he or she was in a union. This seems to us to be more reasonable because
many workers receive the benefits of collectively bargained wages but do not belong to a trade union
or staff association. Secondly, we do not have access to data that compare the wages of the same group
of individuals both when covered by agreements and when not covered. Hence, we cannot, by definition,
estimate the "wage *gain*" from coverage, which would be a true measure of the degree to which unions
are able to influence relative wages. Instead we estimate the "wage-gap", which Lewis (1983, p. 2)
defines as the excess of an individual's real wage if covered by an agreement over his real wage if not
so covered, given his working conditions.

5. The data, and sources, are discussed in the Appendix.

(i)   to indicate the socio-economic group of the individual (SEG)
(ii)   to indicate whether the individual had been employed for more than
       12 months by the same firm (NE12M)
(iii) to denote whether the individual worked in the public sector or not
       (TPUB)
(iv)   to denote if the individual worked on a payments-by-results scheme
       (PBR)
(v)   to denote if the individual was a shift worker (SHIFT)
(vi)   to denote if the individual worked overtime (O/TIME)

Other explanatory variables, that act as proxies for relative employee bar-
gaining power, were included in the set X, having been constructed on an
industry-by-industry basis, viz:

(1)   the number of working days lost per 1,000 employees (STRIKES)
(2)   total resources available per employee to meet pay demands (defined
       as total real income (GDP) less real wages and salaries all divided by
       total employment) (RESOURCE)
(3)   employment growth (EMPG)
(4)   growth of real output (YGROWTH)
(5)   growth of productivity (PRODG)
(6)   average establishment size (total employment in the industry divided
       by the "typical" plant size in the industry obtained from calculating
       a Herfindal index) (SIZE)

Given data constraints, each industry-by-industry proxy is an average of
data for the five years up to and including 1973, except for (1) which uses
data for 1970-1973, (2) which is based on 1971-1973, and (6) which refers
to 1973 only.

Two remaining variables were used in the model: the percentage of workers
covered by a collective agreement for each bargaining group (COVER), and
the status of each individual (covered or not and denoted by the variable
(UNION)).

In order to provide the reader with some appreciation of the data-set
utilised, Table 3 presents arithmetic means of the variables for certain groups
of "covered" and "not-covered" male workers. The salient features are as
follows. First, industrial action occurred more frequently in industries with a
larger proportion of covered workers. It is also noticeable that the growth of
output and productivity was generally lower in "high coverage" industries.
The variable reflecting the amount of resources (profits) available for distri-
bution was generally lower in high coverage sectors. (Each of the variables
mentioned is likely to be affected by relative employee bargaining strength).
Another relevant observation is the greater employment stability in high

Table 3: *Summary of Data Used in Regressions for Males*

Occupations:	All		Manual		Skilled Manual		Semi-Skilled Manual	
	Covered Workers	Not Covered Workers	Covered Workers	Not Covered Workers	Covered Workers	Not Covered Workers	Covered Workers	Not Covered Workers
Variables:								
AHE	£0.82	£0.77	£0.75	£0.66	£0.81	£0.75	£0.75	£0.61
COVER	78.3%	54.2%	75.3%	60.0%	85.6%	76.8%	71.8%	52.9%
STRIKES (per 1,000)	4,671.2	3,654.8	5,864.7	4,136	7,145.7	5,450.9	7,035.4	3,369.9
YGROWTH	3.0%	4.2%	2.2%	3.7%	1.7%	3.0%	2.5%	4.4%
PRODG	2.4%	4.5%	2.4%	4.1%	2.1%	3.6%	2.7%	4.7%
EMPG	0.7%	0.0%	−0.1%	−0.2%	−0.3%	−0.4%	−0.1%	−0.1%
SIZE (employees)	867	370	1,068	411	1,091	329	1,523	563
RESOURCE (per man)	£1,699	£2,617	£1,984	£2,764	£1,833	£1,812	£2,203	£3,486
NE12M	91.7%	87.8%	91.3%	83.5%	93.5%	68.2%	95.9%	89.2%
TPUB	41.2%	6.8%	23.6%	7.1%	13.8%	4.5%	25.7%	8.1%
PBR	25.7%	12.2%	33.8%	16.5%	37.4%	4.5%	35.1%	27.0%
SHIFT	11.3%	2.0%	14.1%	3.5%	8.1%	0.0%	33.8%	2.7%
O/TIME	46.7%	23.6%	54.8%	36.5%	56.9%	45.5%	58.1%	35.1%
n	362	148	263	85	123	22	74	37

Note: Variables are defined in Appendix 1; n refers to number of observations.

coverage sectors: the percentage of workers having been with the same firm for more than 12 months was between 4 and 25 percentage points higher. This suggests that unions attempted to maximise both wage and employment levels. Payment-by-results schemes were more popular in covered sectors, as were shift working and overtime working. Finally, establishment size in high coverage sectors was significantly larger since unions are more likely to organise and exert their bargaining power the larger the employment unit (Marginson, 1984).

Turning to the results obtained when using Ordinary Least Squares (OLS) to estimate Equation (1), Tables 4 and 5 present the major findings. Note, variables that were potentially colinear were omitted from each regression equation that is reported. From a statistical viewpoint, each equation was examined with regard to certain classical assumptions invoked when using the OLS approach. As to the assumption of homoscedasticity, plots of studentised residuals (i.e., a residual divided by an estimate of its standard deviation) against predicted values for the dependent variable did not suggest increasing

Table 4: *Regression Equations of Individual Log of Hourly Earnings, 1973, Males and Females*

Type:	Males		Females	
Occupation:	All	Manual	All	Manual
Variable:				
UNION	0.107 (4.4)	0.066 (3.2)	0.174 (4.0)	0.155 (3.7)
COVER	0.002 (1.7)	0.004 (3.8)	−0.001 (0.9)	−0.000 (0.1)
STRIKES $(\times 10^4)$	0.005 (2.2)	0.082 (4.1)	0.084 (0.8)	
YGROWTH	0.115 (0.2)	2.087 (3.0)		−4.24 (2.8)
PRODG			−2.808 (1.4)	
EMPG	−1.203 (1.4)	−5.449 (5.0)	−0.558 (0.2)	
SIZE $(\times 10^3)$	0.004 (0.5)	−0.017 (2.5)	−0.002 (0.9)	
RESOURCE	0.019 (3.5)	0.014 (3.3)	0.063 (4.8)	0.056 (5.2)
NE12M	0.053 (1.7)	0.044 (1.7)	0.187 (3.9)	0.088 (1.5)
TPUB	0.023 (0.6)	0.030 (0.8)	0.286 (2.9)	0.152 (1.5)
PBR	0.016 (0.7)	0.012 (0.7)	0.094 (1.7)	0.013 (0.3)
SHIFT	0.060 (1.8)	0.095 (3.7)	−0.168 (2.8)	0.088 (0.8)
O/TIME	0.037 (1.9)	0.055 (3.4)	0.059 (1.0)	−0.005 (0.1)
SEG	−0.114 (23.2)	−0.132 (13.7)	−0.091 (8.3)	−0.047 (1.5)
Constant	6.987 (79.8)	6.948 (64.5)	6.273 (34.9)	6.204 (25.7)
R^2	0.56	0.52	0.49	0.44
n	510	348	271	99

Note: t-statistics in parentheses; R^2 is the adjusted coefficient of determination; n represents sample size.

variance. The latter was also used to confirm the assumption that the relation-
ship between the dependent and independent variables is linear. The normality
assumption concerning the distribution of residuals was tested visually using
a histogram plot of the studentised residuals against the expected "normal"
distribution. Finally, the influence of outliers, and whether these significantly
affected the parameter results obtained, were examined, using Cook's Distance
measure. No significant outliers were found, so our results are not biased in
any particular direction because, for example, of the influence of a particular
industry.

Table 5: *Regression Equations of Individual Log of Hourly Earnings, 1973 for Certain*
Male Occupations

Occupation:	Skilled Manual	Semi-Skilled Manual	Unskilled Manual
Variable:			
UNION	0.022 (0.6)	0.142 (4.2)	0.073 (2.6)
COVER	0.002 (1.8)	0.001 (0.5)	0.006 (4.6)
STRIKES $(x10^4)$	0.010 (3.7)	0.007 (1.4)	0.009 (0.3)
YGROWTH	2.151 (2.2)		2.634 (3.1)
PRODG			
EMPG	-8.787 (5.1)	-0.856 (0.4)	-5.031 (4.0)
SIZE $(x10^3)$	-0.016 (1.5)	0.004 (0.2)	-0.022 (1.9)
RESOURCE	0.013 (1.5)	0.009 (1.2)	0.023 (3.7)
NE12M	0.050 (1.2)	0.064 (1.1)	0.054 (1.9)
TPUB	0.202 (3.4)	-0.077 (1.2)	-0.085 (1.8)
PBR	0.021 (0.7)	0.009 (0.3)	0.087 (2.9)
SHIFT	0.106 (2.1)	0.082 (2.3)	0.109 (1.6)
O/TIME	0.048 (1.9)	0.052 (1.8)	0.035 (1.4)
Constant	6.227 (49.8)	6.239 (67.7)	5.714 (57.1)
R^2	0.24	0.41	0.65
n	145	111	74

Note: t-statistics in parentheses; R^2 is the adjusted coefficient of determination;
      n represents sample size.

The wage-gap (or covered/not covered differential) and "extent of coverage"
effects were as follows (after converting from logarithms): Table 6.

The mark-up on covered workers is not particularly high, although it
tended to be larger for female workers and semi-skilled manual males. The
inter-industry variation in coverage had a negligible, although often statis-
tically significant, effect on hourly earnings. Other interesting results in
Tables 4 and 5 that should be particularly highlighted are as follows:

Table 6: *Mark-up on Earnings due to Collective Bargaining in 1973*

Sex:	Males					Females	
Occupation:	All	Manual	Skilled Manual	Semi-skilled Manual	Unskilled Manual	All	Manual
Wage gap (%)	11.27	6.81	2.26	15.31	7.62	19.00	16.76
Extent of Coverage (%)	0.16	0.38	0.25	—	0.63	—	—

(1) the positive "strike" effect for male workers, especially for manual (and in particular skilled manual) male workers;

(2) a surprising negative value for the size variable for male manual workers, which contrasts with *a priori* expectations, and the simple correlation between earnings and size (which was usually highly significant with a positive value);

(3) the importance of the ability-to-pay variable, RESOURCE;

(4) the importance of job stability on hourly earnings, NE12M;

(5) the positive coefficient on TPUB for females, indicating higher wages in the public sector for this group;

(6) the significance of "other pay" for covered workers, especially the importance of shift premium pay and overtime pay.[6]

A similar study to the present one, using NES data for Great Britain, obtained estimates of the "wage-gap" of 4.2 per cent for manual males and 7.0 per cent for manual females in 1973 (Beaumont and Harris, 1986). Hence, the estimates for Northern Ireland are comparable, although higher.

Finally, some comment is necessary on the importance of these results as they relate to the operation of the Northern Ireland labour market. If unions are able to raise the relative wages of those covered by collective agreements, then this implies that they will have an effect upon the distribution of income and resources in the local economy (see Metcalf (1982) for a discussion of the effect of unions upon pay dispersion). More importantly, perhaps, from the standpoint of regional policy, it might be argued that a strong institutional effect through pay bargaining (typically involving nationally negotiated agreements) might be to the detriment of local job creation, if workers price themselves above the "going" market-determined wage rate (see, for example, the 1985 Government White Paper *Employment: The Challenge for the Nation*,

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6. It would appear (from NES figures) that payment-by-results schemes are less important in Northern Ireland, *vis-à-vis* Great Britain.

pp. 13-14, published by the Department of Employment). Our estimates of the "wage-gap" suggest that bringing wages down to the level of those workers not covered by agreements would not lower labour costs sufficiently to have a significant effect upon employment levels. It is also debatable whether national collective bargaining does have a significant impact on relative regional wage differentials (see Beaumont and Harris, 1988).

IV CONCLUSIONS

This paper has provided estimates of the mark-up on wages that accrued to those workers that were covered by collectively bargained pay agreements in 1973. As such, these estimates are unique for the Northern Ireland economy. The paper has not looked in detail at the collective bargaining structure, what determines it and how it has changed over time (*vis-à-vis* the bargaining structure in Great Britain), since this will be the content of a subsequent paper to be published in this journal.

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Appendix 1: *Data Sources*

STRIKES — number of actual days lost due to industrial action divided by employees in employment (per 1,000) (Department of Economic Development, Belfast, unpublished data).

YGROWTH — percentage change in the index of industrial production (1975 = 100) (Northern Ireland Digest of Statistics, 1979 and Statistical Review of Northern Ireland Agriculture, 1979)

EMPG — percentage change in employees in employment (Northern Ireland Digest of Statistics, 1975)

RESOURCE — GDP (£m) minus income from employment (£m) all in constant 1975 prices (Economic Trends Regional Accounts, 1976 and 1977)

PRODG — percentage change in the index of industrial production divided by employees in employment (normalised 1975 = 100) (Northern Ireland Digest of Statistics, 1975 and 1979)

SIZE — average establishment size (total employment in the industry divided by the "typical" plant size in the industry obtained from calculating a Herfindal index (Department of Economic Development unpublished data, 1973)

Appendix 2: *Derivation of Equation*

This is a restricted form of Equation (1) in Lewis (1983), since we are assuming that there are no cross-product interactions between U and the set of explanatory variables X, or the "extent of coverage" variable Y. Note that this equation can be rewritten (and is sometimes estimated) as two separate equations, which allow the reader some insights into how the "wage-gap" is being measured:

$$\ln W_{uj} = a_u + a_{ux} X_{ij} + a_{uy} Y_j \quad \text{if } U = 1$$

$$\ln W_{nj} = a_n + a_{nx} X_{ij} + a_{ny} Y_j \quad \text{if } U = 0$$

Hence,

$$\ln W_{ij} = \ln W_{nj} + \ln (W_{uj} - W_{nj}) = a_n + a_{nx} X_{ij} + a_{ny} Y_j +$$

$$U_{ij} \left[(a_u - a_n) + (a_{ux} - a_{nx}) X_{ij} + (a_{uy} - a_{ny}) Y_j \right]$$

As already stated, we are assuming that all terms in square brackets in the latter equation, other than the first, are zero.