Economic and Social Review, Vol. 10, No. 3, April, 1979, pp. 231–254.

Non-Wage Costs, Employment and Hours of Work in Irish Manufacturing Industry

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Précis: This paper presents a recursive model of the short-run demand for workers and hours in Irish industry. On the assumption that employers minimise costs, the optimal employment/hours mix is shown to be a function of the ratio of non-wage to wage costs. A series of non-wage costs, comprising employers' social insurance, redundancy and pay-related contributions, is constructed and the model estimated with encouraging results. The steady rise in the importance of non-wage costs appears to have exerted a depressing effect on the level of employment. The resulting implications for a job creation strategy are then explored.

I INTRODUCTION

The cost to an entrepreneur of hiring labour consists not only of the wages and salaries paid to employees, but also includes the employer's search costs, his statutory social insurance contributions, and any training expenditures incurred. Labour costs may, therefore, be subdivided into wage and non-wage (or "fixed") components, to adopt the terminology proposed by Oi (1962). Such non-wage costs are in general a function of the size of the workforce and are largely independent of its degree of utilisation. The effects of these costs on the aggregate relationship between employment and output and on the desired level and utilisation of the workforce have been explained by Soligo (1966), Rosen (1968) and Fair (1969) for the US and by Wickens (1974), Hart and Sharot (1978), and Nickell (1979) for Britain. The broad conclusions of these studies are that fixed labour costs render employment less sensitive to output fluctuations by encouraging labour

* The author acknowledges the advice and comments of D. N. F. Bell, R. A. Hart, J. W. McGilvray, B. M. Walsh, the referees and the editors of this journal, upon whom responsibility for any remaining errors cannot be devolved.

hoarding, reduce the desired level of employment corresponding to a particular level of output, and increase the desired utilisation of the retained workforce.

This paper attempts to model such effects in the Irish manufacturing sector. A series of non-wage costs is constructed and embedded in a model of cost-minimising firm behaviour analogous to that of Brechling (1965). Estimation of the resulting model suggests that the steady rise in the proportion of total labour costs accounted for by non-wage components has exercised a significant depressing effect on the level of employment in Ireland.

II THEORETICAL CONSIDERATIONS

II.1 The Employment-Output Relationship

The model developed here is of a similar nature to those of Brechling (1965) and Ball and St. Cyr (1966) in that it is primarily concerned with the firm's short-run decisions on the size of its workforce and the length of the work week. The existing capital stock and the state of technology are exogenously given. For simplicity the production function is assumed to be of the Cobb-Douglas type, namely,

$$Q_t = AL_t^{\alpha}K_t^{\beta} \tag{1}$$

where Q = output,
L = the input of labour services,
K = the input of capital services,
A = a technological constant, and
t = a time subscript.

Quarterly capital stock estimates are not available for Irish manufacturing industry, and so the influence of capital stock and technical progress are absorbed by a simple exponential trend to yield

$$Q_t = AL_t^{\alpha}e^{jt} \tag{2}$$

thus assuming that the effect of changes in relative factor prices on the optimal long-run capital stock is a smooth one. Under the assumption that firms produce differentiated products and exercise substantial price-fixing powers in the short run, output may be treated as exogenous and (2) inverted to yield a demand for labour services function,

$$L_t = A^{-\frac{1}{\alpha}} Q_t^{\frac{1}{\alpha}} e^{-\frac{jt}{\alpha}} \tag{3}$$

The input of labour services (L_t) is a function both of numbers employed (N_t) and average hours worked (H_t) – that is,

$$L_t = g(N_t, H_t) \tag{4}$$

where $\frac{\partial L}{\partial N}, \frac{\partial L}{\partial H} > 0$.

There are important reasons for explicitly considering both components of the aggregate labour input. Feldstein's (1967) empirical results suggest that the output elasticity of hours is significantly greater than the corresponding elasticity of employment and that the rate of service flow from hours is an increasing function of average hours (i.e., the marginal flow from hours per man always exceeds the average). Two explanations for this finding are suggested by Feldstein –

(i) an increase in hours increases the flow of capital services, and

(ii) a number of hours during each working week may be regarded as a fixed labour cost with no corresponding output because of setting-up time, work breaks, time around lunch-hour, etc. By contrast, overtime hours are relatively free from such interruptions.

Appropriate specification of the labour input decision, therefore, implies the determination of two variables – the number to be employed and the average hours worked. Both these magnitudes are assumed to be completely demand-determined in this model.

Following Brechling (1965), the employment/hours mix chosen is dictated by considerations of cost minimisation. Brechling minimised the total wage bill, however, whereas what is minimised here is the total cost of employing labour (i.e., the sum of wage and non-wage (or fixed) components).

Consider first the wage element. This will depend on

(a) the numbers employed (N_t),

(b) the number of hours (HS_t) paid for at standard rates of pay (w_1), and

(c) the number of hours (HP_t) paid for at overtime rates of pay (w_2).

The total wage bill (W) is, therefore, (omitting time subscripts)

$$W = N[HSw_1 + HPw_2] \tag{5}$$

However, total hours worked (H) are the sum of standard (HS) and overtime (HP) hours, so that

$$H = HS + HP$$

If the further assumption is made that overtime rates are some constant multiple of standard rates, such as time and a half or double time, so that

$$w_2 = \beta w_1 \qquad \beta > 1$$

then the total wage bill (W) may be expressed as

$$W = N[(1-\beta)HS + \beta H]\, w_1 \tag{6}$$

The simplest assumption to make about the fixed costs is that the total of such costs to the firm (NW) may be approximated by the product of the number employed (N) and the level of non-wage costs per employee (nw). Thus,

$$NW = N \cdot nw \tag{7}$$

The total cost to the firm of hiring labour (C) is, therefore, the sum of (6) and (7) –

$$C = N\left\{[\,(1-\beta)\, HS + \beta H]\ w_1\ + nw\right\} \tag{8}$$

The firm is assumed to achieve its desired input of labour services, $L^* = g(N^*, H^*)$, by choosing those levels of employment and average hours at which (8) will be minimised. Given the standard rate of pay (w_1), the problem becomes one of constrained minimisation such that

$$\underset{\{N,\,H\}}{\text{Min}}\ {}^{C}/w_1 = N[(1-\beta)HS + \beta H + \frac{nw}{w_1}]\ \text{s-t.}\ L = g(N, H) \tag{9}$$

Forming the Lagrangean and reintroducing time subscripts,

$$Z = N_t[(1-\beta)\, HS_t + \beta H_t + \left(\frac{nw}{w_1}\right)_t] + \lambda[L_t - g(N_t, H_t)] \tag{10}$$

and resulting standard conditions for a minimum are

$$Z_n = (1-\beta)HS_t + \beta H_t + \left(\frac{nw}{w_1}\right)_t - \frac{\lambda \partial g}{\partial N_t}(\ldots) = 0 \tag{11}$$

$$Z_h = \beta N_t - \frac{\lambda \partial g}{\partial H_t}(\ldots) = 0 \tag{12}$$

$$Z_\lambda = L_t - g\,(N_t, H_t) = 0 \tag{13}$$

where Z_n, Z_h, and Z_λ represent partial derivatives.

These conditions constitute a set of three implicit functions of the form

$$F^i\,(Y_1, Y_2, Y_3; X_1, X_2, X_3) = 0 \qquad i = 1, 2, 3$$

where the set (Y_1 = H, Y_2 = N and Y_3 = λ) are endogenous and the set (X_1 = HS, X_2 = L and $X_3 = \frac{nw}{w_1}$) are exogenous. By virtue of the implicit function theorem, explicit functions of the form

$$N_t^* = f_1\left[HS, L_t, \left(\frac{nw}{w_1}\right)_t\right] \tag{14}$$

$$H_t^* = f_2\left[HS, L_t, \left(\frac{nw}{w_1}\right)_t\right] \tag{15}$$

exist in some neighbourhoods within the domain of each function which express the cost-minimising levels of the endogenous variables, N_t and H_t, in terms of the exogenous variables, HS, L_t and $\left(\frac{nw}{w_1}\right)_t$. On substitution from (3), (14) and (15) may be re-written

$$N_t^* = f_1\left[HS, Q_t, t, \left(\frac{nw}{w_1}\right)_t\right] \text{ and} \tag{16}$$

$$H_t^* = f_2\left[HS, Q_t, t, \left(\frac{nw}{w_1}\right)_t\right] \tag{17}$$

These expressions for desired levels of employment and hours are almost identical to those derived by Brechling (1967), except that the ratio of non-wage costs has replaced Brechling's ratio of overtime to standard wage rates. We turn now to a consideration of the role of non-wage costs in equations (16) and (17).

II.2 Non-Wage Costs of Labour

As indicated above, the non-wage costs of employing a unit of labour fall into two categories — (i) once-off transactions and investment expenditures (F_1) and (ii) recurrent expenditures (F_2). Each of these categories will now be considered in turn.

The once-off fixed costs of labour are incurred at three stages in the employment process. First, there are search costs associated with the hiring of additional labour, namely, the advertising, interviewing and selection costs incurred by an employer. Secondly, further investment in human capital may be required to enable the newly-hired employee to function efficiently. As noted by Becker (1962), such costs will only be wholly borne by the employee in the case where the training given is of such a general nature as to be of value in a wide range of alternative employments. In cases where the training is partly or wholly specific to the employment in question, a portion of the costs will be borne by the employer. This results in human capital investment expenditure "sunk" in that particular employee. Finally, there are fixed costs in the nature of redundancy and pension payments associated with the firing process. The extent to which such once-off non-wage costs will be incurred by the employer in a given period will obviously depend on the rate of labour turnover (q) within his establishment.

By contrast, the recurrent non-wage costs are dependent almost solely on the numbers employed and consist of such expenditures as social insurance contributions, holiday pay, and fringe benefits of either a statutory or collectively agreed nature. Given a labour force at time t (N_t), the employer's total non-wage bill may, therefore, be written as

$$NW_t = [F_1(q_t) + F_2]N_t$$

It is obvious that one way in which a cost-minimising employer may reduce his non-wage costs is by damping down fluctuations in his level of employment, thereby reducing the turnover rate. Thus, non-wage costs are likely to affect the manner and speed with which the actual labour force is adjusted to its desired level.

Non-wage costs will also affect the employment adjustment process through another channel, namely, that of the employer's output expectations. As noted above, there are non-wage costs attached to hiring and firing. In recruiting, costs are incurred in advertising for and in screening potential applicants. Those appointed may also require training. In view of these costs, firms will be reluctant to hire additional workers until they are sure that their output expectations are well founded.

A similar line of reasoning holds where there is a decline in product demand and a consequent decrease in the required input of labour services. The level of employment will be reduced and non-wage costs of redundancy and severance pay incurred only if the new lower level of product demand is expected to persist. Over the cycle the net effect will be to make the level of employment less sensitive to variations in output. In a recession this may well be advantageous as it retards the rise in unemployment, but the converse is true in the recovery where employment rises much less rapidly than output.

Indeed, as Nickell (1979) points out, non-wage costs may actually lead to a decline in average employment over the cycle. At the margin a cost-minimising employer will equate the ratio of the marginal productivity of an additional overtime hour (MP_{hp}) and the marginal productivity of an hour's new employment (MP_n) to the ratio of their marginal costs. The marginal cost of an overtime hour is w_2, the overtime wage rate, while that of an hour's additional employment consists of the standard wage rate, w_1, plus that portion of non-wage costs attributable to an hour of additional employment, $\frac{nw}{h}$. The equilibrium condition is, therefore,

$$\frac{MP_n}{MP_{hp}} = \frac{w_1 + \frac{1}{h} nw}{w_2} = \frac{1 + \frac{1}{h}\frac{nw}{w_1}}{w_2/w_1} \tag{18}$$

Given an increase in non-wage costs and no variation in wage rates, equilibrium can be restored to (18) by an increase in the marginal product of employment, which in turn entails a reduction in the level of employment, or, alternatively, through a decrease in the marginal product of hours which results from an increase in the number of overtime hours worked. In reality, equilibrium is restored through offsetting reductions in employment and increases in hours. However, given the earlier assumption of a constant ratio between overtime and standard rates of pay, a further avenue of adjustment is available. A general rise in wage rates may offset the rise in fixed costs and prevent the ratio of non-wage to wage costs from increasing. However, a glance at the data on Irish non-wage costs (see Appendix 1) shows that this in fact has not been the case, the ratio having more than doubled over the period 1969-1977. The situation is similar in other European countries (Eurostat, 1975). Thus, in the employer's pursuit of cost minimisation, the rising ratio of non-wage to wage costs will lead to a short-run substitution of overtime hours for employment. In the longer run, increases in the real levels of both components of labour costs are likely to lead to capital substitution.

Two conclusions are clear. The existence of non-wage costs biases the firm's desired cost-minimising levels of employment and hours in favour of the latter. At the same time, such fixed costs lead to a lagged adjustment of employment to its desired level. Consequently, there is further short-run substitution of hours and employment. We expect, therefore, that

$$\partial N^* / \partial \frac{nw}{w_1} < 0 \quad \text{and}$$

$$\partial H^* / \partial \frac{nw}{w_1} > 0$$

In the light of the foregoing discussion, equations (16) and (17) must be modified to take account of three factors:

(1) the lagged adjustment of actual to desired employment,

(2) the substitution possibilities between numbers employed and hours of work, and

(3) the employer's output expectations.

We now consider each of these factors in turn.

II.3 THE EMPLOYMENT ADJUSTMENT FUNCTION

A comprehensive catalogue of reasons for the lagged adjustment of actual to desired employment has been set out by Soligo (1966). However, it is the non-wage costs of adjusting to equilibrium which directly affect the employer's cash flow and which are, therefore, of major importance in a cost-minimising framework. Consider the case where the level of demand has fallen and a reduction in numbers employed is desired. Such a reduction may involve lump-sum redundancy payments and the writing-off of whatever human capital investments the firm has made in the redundant employees. Conversely, non-adjustment of the level of employment results in needless recurrent non-wage expenditures on that part of the work force ($N_t^* - N_t$) which is surplus to current requirements.

The non-wage costs of disequilibrium are a function, therefore, of the extent of the disequilibrium ($N_t^* - N_t$) and of any adjustment towards equilibrium ($N_t - N_{t-1}$). If both these costs are assumed to be quadratic, then, as shown by Holt and Modigliani (1961), the optimal course of action is to spread the required adjustment over several periods. Formally, the problem is to select N_t in order to minimise

$$C = \alpha_1 (N_t^* - N_t)^2 + \alpha_2 (N_t - N_{t-1})^2 \tag{19}$$

given N_t^* and N_{t-1}.

Differentiating (19) and equating C to zero yields the partial adjustment model

$$N_t - N_{t-1} = \lambda(N_t^* - N_{t-1}) \tag{20}$$

where $\lambda = \dfrac{\alpha_1 + \alpha_2}{\alpha_1}$.

For the purposes of this paper it will be convenient to work with the logarithmic form of (20),

$$\left(\frac{N_t}{N_{t-1}}\right) = \left(\frac{N_t^*}{N_{t-1}}\right)^{\lambda} \tag{21}$$

Soligo (1966) has shown that the adjustment path implied by (21) will only deviate significantly from that implied by the linear partial adjustment model when the gap between desired and actual values is very large. The main difference between the two (see Deaton (1977)) is that the logarithmic form is asymmetrical, by contrast with the linear, and implies higher costs of downward adjustment and correspondingly lower costs of upward adjustment. This partial, and therefore incomplete, adjustment of actual to desired employment implies a continuing disequilibrium in numbers employed which must be accommodated by an offsetting disequilibrium in average hours if the required labour input is to be forthcoming.

II.4 Employment-Hours Substitution

The substitution possibilities between the two components of the aggregate labour input have recently been explored in some detail by Hart and Sharot (1978). Their approach lay implicit, but undeveloped, in Brechling's (1965) seminal paper on labour demand functions where separate employment and hours equations were specified. Brechling, however, developed only the former and neglected any interdependence between the two equations. The vast majority of subsequent contributions to this field followed this lead, with a few notable exceptions. Nadiri and Rosen (1969), for example, allow a complex interdependence between disequilibria in factor stocks and in their rates of utilisation.

The logical necessity to consider such substitution possibilities is highlighted by Fair (1969) who points out that if a labour demand function is not to be inconsistent, then the labour variable subject to a lagged adjustment process in (21) above must not be the same labour services variable which enters the production function. For were the variable the same where L_t^* is the desired input of labour services and L_t is incapable of adjusting instantaneously to this desired level, then the required output could not be produced. In this and similar models, where numbers employed are subject to a lagged adjustment process, completeness requires that account be taken of the substitutability of hours for workers in attaining the desired labour input. The approach adopted here is that of Hart and Sharot (1978) who specify a recursive model in which hours are varied to accommodate the excess demand for workers which arises because of the sluggish adjustment of actual numbers employed.

The relationship between the input of labour services (L_t) and its constituent components, the numbers employed (N_t) and average hours worked (H_t), may be conveniently illustrated diagramatically. On the assumption that the marginal rate of substitution of employment for hours is a decreasing function of employment, (4) may be represented in the conventional form of convex isoquants as in Figure 1. Each isoquant maps the combinations of workers and hours which provide a given input of labour services.

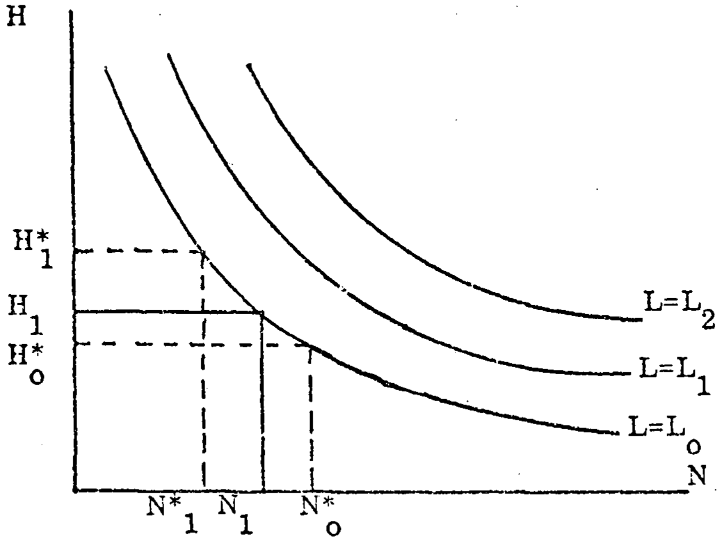

Figure 1. The functional relationship between the number employed (N) and hours worked (H).

The equilibrium condition (18) then yields the cost-minimising factor combination, denoted by H_0^*, N_0^*, representing, in effect, the equilibrium values determined by (16) and (17). Assuming that the isoquant constraint is binding, any divergence of actual employment (N_t) from its desired level (N_t^*) must be accommodated by offsetting departures of actual hours (H_t) from their desired levels so that, given isoquants which are log-linear over the relevant range,

$$\frac{H_t^*}{H_t} = \left[\frac{N_t^*}{N_t}\right]^{\Phi} \qquad \Phi < 0 \qquad (22)$$

Consider Figure 1 with the firm in equilibrium at the employment/hours mix, N_0^*, H_0^*. An increase in the ratio of non-wage to wage costs, all other factors held constant, will lead to a fall to N_1^* in the desired number of employees and a rise to H_1^* in the desired level of hours. However, only a fraction of the gap $(N_1^* - N_0^*)$ – a fraction determined by the size of λ in (21) – will be closed in the first period. Thus the employer's initial reaction is to reduce employment to N_1, rather than N_1^*. The greater than desired labour force $\left[\frac{N_1^*}{N_1} < 1\right]$ is accommodated by actual hours below their desired level $\left[\frac{H_1^*}{H_1} > 1\right]$. Over time the labour force is reduced to N_1^* and in compensation average hours rise to H_1^*. We, therefore, expect that

$$\frac{\partial H}{\partial(N^*/N)} > 0$$

A similar conclusion is reached where the level of output varies, all other factors held constant. Both cases outlined here consider the process of adjustment from one static equilibrium to another. However, once dynamic adjustment paths are considered, it can be shown that there is one important case in which the sign of the partial derivative is negative, namely, where the ratio of non-wage to wage costs has risen or fallen monotonically over time. This case has important practical relevance as the ratio has, apart from seasonal effects, been rising steadily over the years, both in Ireland (see Appendix 1) and in the other EEC countries (Eurostat, 1975).

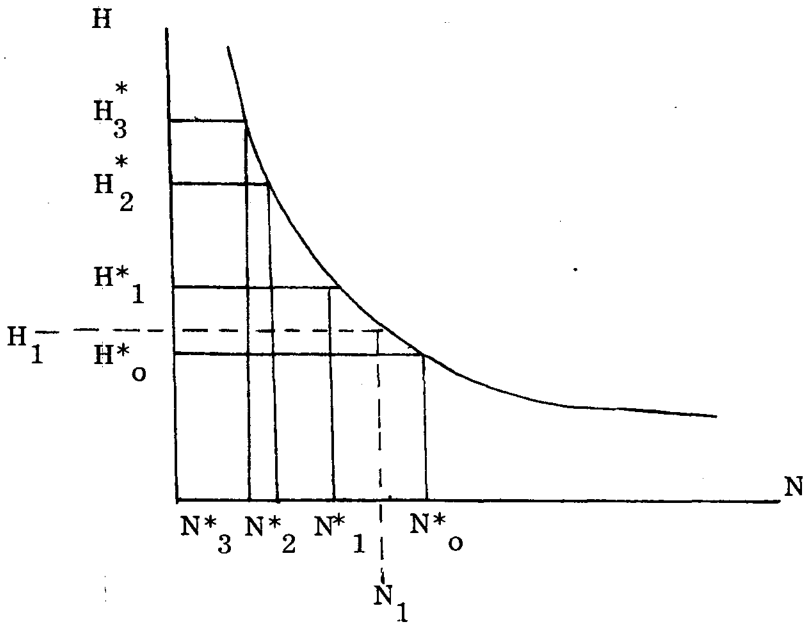

Figure 2. The functional relationship between the number employed (N) and hours worked (H), assuming the operation of the adjustment effect.

Figure 2 illustrates this case, all other factors held constant. The desired level of employment falls continuously while that of hours rises. By virtue of the partial adjustment process (21), the ratio between desired and actual employment (the excess demand for employment (N^*/N)) declines over time. The compensating increase in hours required if the isoquant constraint is to hold can only come about in this case if

$$\frac{\partial H}{\partial (N^*/N)} < 0$$

Hart (1978) has referred to this as the adjustment effect. It is clear that where this effect and the shift effect caused by movement between isoquants are both present, the sign of the derivative is *a priori* unpredictable.

In the British case, where industrial output has grown very slowly, Hart and Sharot (1978) obtain a negative sign. The adjustment effect of a rising non-wage ratio appears to nullify the weaker output shift effect. In Ireland, where industrial production has been considerably more buoyant and the rise in the non-wage ratio less pronounced, a positive sign might on balance be expected.

II.5 Employers' Output Expectations

As noted above, desired levels of employment and hours depend on employers' expectations about future levels of output, as well as the current levels; the equations (16) and (17) should be modified to take account of this. The simplest modification is that suggested by Brechling (1965) where the expected output in the next period (Q^{ϵ}_{t+1}) is assumed to be based on the current period's level, modified by a function of the most recently experienced change in output,

$$Q^{\epsilon}_{t+1} = \left[Q_t \frac{Q_t}{Q_{t-1}}\right]^{\eta} \qquad n \lesseqgtr 0 \qquad (23)$$

In effect, this amounts to the addition of a term relating to the change of output to equations (16) and (17), the expectational scaling factor, n, being determined in the regressions. An alternative measure of expected output may be derived by applying a Box-Jenkins (1970) analysis to the suitably differenced historical output series, choosing the most appropriate representation and using the fitted values (Q^*) as an explanatory variable in the regressions.

II.6 The Complete Model

The three modifications noted above, namely, lagged adjustment (21), employment/hours substitution (22) and output expectations (23), are now made to equations (16) and (17), thereby eliminating the unobservable desired level variables, N^* and H^*. Rewriting the modified equations in log-linear form then yields

$$N_t = A_1 HS^{\lambda\tau_1} Q_t^{\lambda\tau_2} \left(\frac{nw}{w_1}\right)_t^{\lambda\tau_3} N_{t-1}^{1-\lambda} e^{\lambda\tau_4 t} \quad (24)$$

$$H_t = A_2 HS^{\beta_1} Q_t^{\beta_2} \left(\frac{nw}{w_1}\right)_t^{\beta_3} \left(\frac{N^*}{N}\right)_t^{\beta_4} e^{\beta_5 t} \quad (25)$$

Depending on which specification of expected outputs is used, a logarithmic term relating to the change in output is added to both equations, or alternatively the Box-Jenkins forecasts ($Q_t^\dagger$) are used to replace the actual output variable in the employment and hours equations. The resulting log-linear two-equation system, based on (24) and (25), forms the model for estimation purposes.

The basic hypothesis to be tested is that the ratio of non-wage to standard wage costs $\left(\frac{nw}{w_1}\right)$ will exert a negative influence on the numbers employed and a positive influence on the average levels of hours worked.

III DATA AND ESTIMATION CONSIDERATIONS

III.1 Data

The paucity of Irish economic statistics raises certain problems and means that some of the variables can only be approximated by available related data. The dependent variable in the employment equation falls into this category in that ideally the model should be estimated separately for both male and female workers as there are substantial differences between the sexes in wages and hours worked. Furthermore, the ratio of non-wage to wage costs tends to be significantly higher for females than for males. However, while data are available by sex on average hours and average earnings in manufacturing, no quarterly time series breakdown of employment by sex exists. We are, therefore, constrained to use total manufacturing employment as the dependent variable in equation (24) and average hours worked by all industrial employees in equation (25). A caveat must, however, be entered on the nature of the latter varible. The published data refer to the number of hours worked in a week during each quarter. However, it would appear that the week in question is always one in which a full number of days are worked. The series, therefore, fails to map the effect of a rising number of public and private holidays. Over the estimation period 1969-77 this effect seems unlikely to be of major importance.

There is no official series on standard hours in Irish manufacturing industry. What evidence is available from successive Employment Period Orders and National Agreements suggests that a standard forty-hour week has operated in industry since the late 1960s. The implied absence of variation in the HS variable suggests that its deletion is unlikely to result in significant specification bias. The role of the HS variable is, therefore, absorbed by the intercept term for estimation purposes.

The bi-sexual nature of the dependent variables requires a similar specification of the fixed costs variable $\left(\frac{nw}{w_1}\right)$, the ratio of non-wage to standard rates of pay. The only wage data available for Irish manufacturing industry relate to earnings and so include a contribution from hours worked at premium rates of pay. An attempt to purge this element was made by assuming that all hours worked in excess of the standard forty-hour work week are paid for at premium rates. Given an estimate of the ratio of premium to standard rates, a series of standard earnings can be extracted to serve as the denominator of the non-wage ratio. Two such standard earnings series were in fact extracted, corresponding respectively to overtime rates of "time and a half" and "double time". Comparison of the resulting non-wage ratio series with the 1975 EEC Labour Cost Survey suggested that the former was most appropriate, and accordingly the latter was discarded.

The non-wage component of the ratio was calculated as follows. For both males and females, three categories of fixed costs were identified:

(i) the employer's statutory social insurance contributions,

(ii) the employer's statutory redundancy fund contributions, and

(iii) the employer's statutory pay-related contributions.

The sum of these contributions was expressed as a percentage of the standard earnings series derived above for each sex. The aggregate ratio was then derived as a weighted average of the two ratios, the annual weights corresponding to the sex distribution of employment in manufacturing industry as revealed by the Census of Industrial Production for years up to 1975.[1] The EEC Labour Force Survey provided weights for 1977, while those for 1976 were interpolated from the two adjacent years.

Ideally, the fixed cost components included in this series should be invariant to the average level of hours worked. To a minor extent, this desirable property is violated. The third category of non-wage cost includes the employer's pay-related contributions, which are based only on earnings up to a level of £50 per week; thereafter they become a flat-rate charge. Thus, where weekly earnings are less than £50, the employer's contribution is effectively a function of hours worked. For the period under scrutiny, however, the problem is not a serious one. Pay-related contributions were introduced in April 1974 and so the problem does not arise for the major part of the estimation period. For the quarters after its introduction the distorting effect is concentrated on female non-wage costs, the weighting of which in the aggregate non-wage ratio is just under 30 per cent during this period. Average male adult earnings in manufacturing passed the £50 threshold by April 1975, so that the only male observations affected

1. Unpublished CIP data for 1974 and 1975 were kindly supplied by CSO.

are those for the intervening year. This data deficiency is noted here, but examination of the calculated non-wage ratio series and the econometric results presented below do not suggest that any distortions induced significantly affect the reported conclusions.

The output variable used was the index of industrial production for all manufacturing industry derived from the Quarterly Industrial Inquiry. Data on average earnings and hours worked were derived from the same source, the reference volume being the Central Bank's Folder of Economic Statistics (1978). The employment, output and average hours variables were all expressed in index form (base 1970 = 100). The data used were not seasonally adjusted and a series of dummies was accordingly included in each equation. The preference for unadjusted data reflects the fact that where time series are separately filtered to remove frequency components at or near seasonal frequencies, such filtering may distort the relationship between pairs of series and, in particular, may alter underlying dynamic reactions.

The construction of the aggregate non-wage ratio from separate male and female ratios, which is considered desirable in order to take account of the proportionately higher female non-wage costs and the changing sex composition of employment, means that the estimation period cannot begin before the third quarter of 1969, the earliest date for which separate male and female earnings were published on a quarterly basis. The inclusion of a lagged dependent variable in the employment equation means the loss of one observation, so that the sample period becomes the final quarter of 1969 to the second quarter of 1977, a total of 31 observations.

III.2 Estimation

Preliminary Ordinary Least Squares (OLS) estimation suggested the presence of positive autocorrelation in both equations. OLS is, therefore, an inappropriate estimation technique in this model. This conclusion is reinforced by the presence of a lagged dependent variable amongst the regressors in the employment equation. The combination of such a variable and autocorrelated disturbances renders OLS inconsistent (Johnston, 1972). An appropriate three-stage estimation for such an equation has been proposed by Wallis (1967). The suggested method uses instrumental variable techniques to produce a consistent estimation of the autocorrelation parameter, ρ, which is in turn used to form a generalised least squares estimation. Johnston notes that the resulting estimates will be consistent, though not fully efficient, as the true value of ρ is unknown. This technique was used to estimate the employment equation (24).

The unobservable excess demand for employment variable in (25), $\frac{N_t^*}{N_t}$, may be transformed from (21) to yield

$$\frac{N_t^*}{N_t} = \left[\frac{N_t}{N_{t-1}}\right]^{(1-\lambda)/\lambda} \tag{26}$$

which is then substituted into the hours equation (25). Estimation of this equation was carried out using the Cochrane-Orcutt (1949) iterative technique.

IV THE RESULTS

Table 1 presents the results of estimating equations (24) and (25). Two series of results are presented, corresponding to the two alternative specifications of employers' output expectations. Equations (3) and (4) of Table 1 embody the adaptive expectations mechanism (23), while equations (1) and (2) used the results of the Box-Jenkins analysis. As is clear from the table, all coefficients are of the expected sign and there is little to choose between the two sets of results in terms of goodness of fit. In both cases, the proposed specification accounts for over 95 per cent of the variation in the employment series and over 85 per cent of that in average hours. Furthermore, the coefficient estimate of most interest here, that on the non-wage ratio, does not appear unduly sensitive to the choice of expectations specification.

Before considering the estimated effects of non-wage costs in detail, some specific features of the results may be pointed out. The average lag in the adjustment of employment, given by $(1 - \lambda)/\lambda$ in (26), is of the order of eight months when the Box-Jenkins measure of output is used and of five months in the adaptive expectations case. The former estimate corresponds closely to that of Smyth and MacMahon (1975), while the latter represents somewhat more rapid adjustment. The estimates presented here suggest that somewhere between 27 and 41 per cent of the discrepancy between desired and actual levels of employment is closed within three months of its arising. By contrast, the results of introducing a lagged dependent variable in the hours equation suggests that average hours adjust almost instantaneously, vindicating the Hart and Sharot (1978) hypothesis that hours adjust to accommodate the short-term excess demand for employment. The strength of the excess demand variable in the hours equation lends further support to this interpretation. As Figure 3 shows, hours move closely in step with the excess demand for employment, rising and falling as the ratio of desired to actual employment increases and declines.

Table 1: *Regression Results*

Equation No.	*Method of estimation*	*Dependent variable*	*Intercept*	Q_t	$\frac{Q_t}{Q_{t-1}}$	Q^*_t	N_{t-1}	$\frac{nw}{w_1}$	$\frac{N^*}{N_t}$	τ	R^2	*DW*	*h*
(1)	Wallis	N_t	1.417			0.05	0.73	–0.035		0.0003	0.99		0.15
						(1.85)	(6.43)	(–2.39)		(0.49)			
(2)	CORC	H_t	7.025			–0.004		0.02	0.23	–0.001	0.86	1.70	
	[ρ = 0.68]					(–0.19)		(1.66)	(4.07)	(–2.12)			
(3)	Wallis	N_t	1.147	0.24	–0.09		0.59	–0.026		–0.002	0.99		0.86
				(4.26)	(–1.68)		(6.07)	(–1.99)		(–2.71)			
(4)	CORC	H_t	6.796	0.03	–0.03			0.02	0.43	–0.001	0.86	1.67	
	[ρ = 0.64]			(0.60)	(–0.64)			(1.46)	(3.84)	(–2.02)			

Notes:
(1) Figures in parentheses are t- statistics.
(2) "h" is Durbin's (1970) test for autocorrelation when one of the regressors is a lagged dependent variable.
(3) CORC denotes Cochrane-Orcutt.
(4) ρ is the sample autocorrelation coefficient.

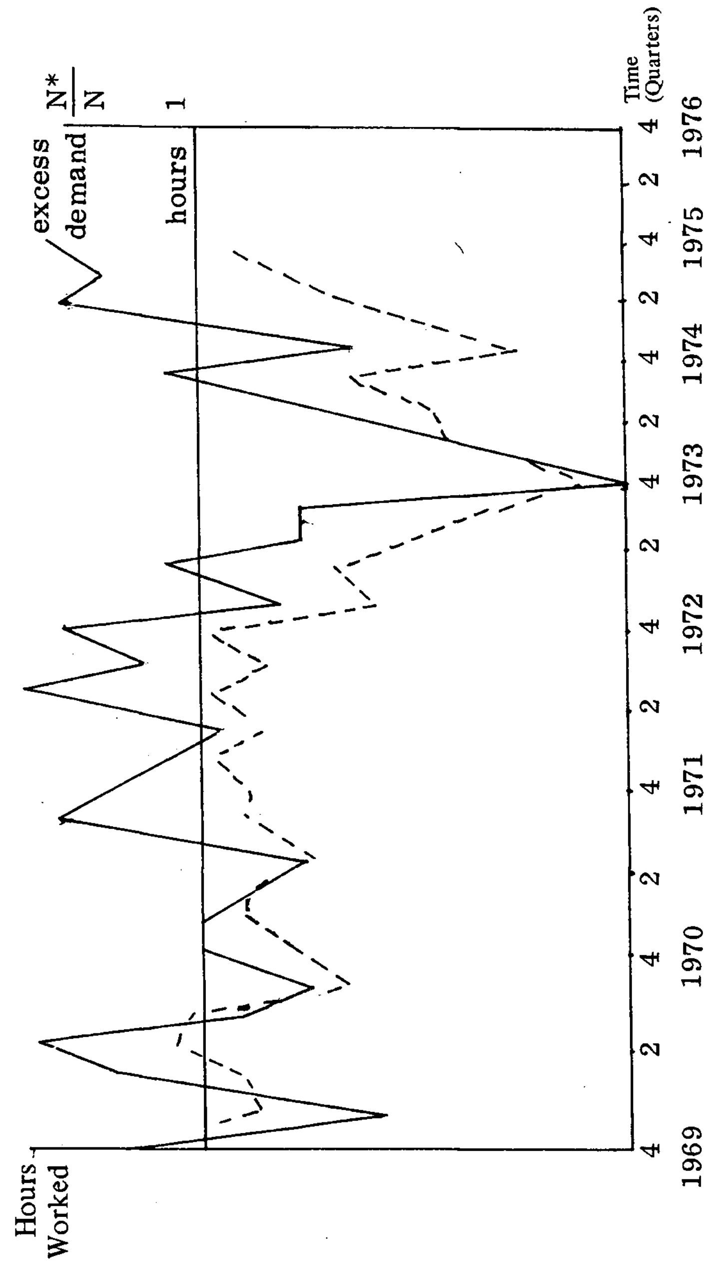

Figure 3. Excess demand for labour and average hours worked in Irish manufacturing industry, 1969-1976.

Sources: Hours – Quarterly Industrial Inquiries.
Excess demand – derived from equation (26).

Turning to the impact of non-wage costs, it can be seen that this variable, $\frac{nw}{w_1}$, exerts the expected negative effect on the level of employment. The point estimate of the elasticity of employment with respect to a change in the ratio of non-wage to wage costs derived from equations (1) and (3) of

Table 1 is of the order of -0.03. This suggests that a one per cent rise in the fixed cost ratio will cause a fall of 0.03 per cent in employment, *ceteris paribus.* Given the scale of Irish manufacturing industry, this is equivalent to reducing the level of employment by some 65 workers below what it might otherwise have been. However, the results of the 1977 Labour Force Survey indicate that manufacturing accounted for under 22 per cent of total employment in Ireland at that time, so that if a similar relationship exists in the remainder of the non-agricultural sector the economy-wide effects are likely to be considerably larger. Thus, the introduction of pay-related social insurance contributions in April 1974, which along with other coincident changes appears to have raised the non-wage ratio by 2.1 points or over 30 per cent during the following twelve months, must have considerably exacerbated the effects of the world recession on employment in Ireland. Our estimates would suggest that these changes depressed the level of manufacturing employment by some 2,000 below what it would otherwise have been. If non-wage costs induce similar behaviour in other non-agricultural sectors, the economy-wide negative employment effect would have been of the order of 7,000 jobs.

In the hours equation, the non-wage ratio again performs as anticipated, exerting a positive influence on the number of hours worked. The coefficient estimate is quite plausible, suggesting that, all other factors held constant, full adjustment of employment to the changes in non-wage costs in 1974-75 would be accommodated by an increase of two and a half hours in the length of the average work week.

One final point should be noted about the effects of non-wage costs in this model. The only substitution permitted is between employment and hours. The implication is that an equi-proportional increase in both non-wage costs and standard wages, which leaves the non-wage ratio unchanged, will have no impact in the short run on levels of employment and hours of work. In the longer run, however, capital substitution may be expected. Appendix 2 presents the results of re-estimating the equations of Table 1 with a real wage variable (RW) included to capture this long-run effect. The real wage was proxied by the standard earnings series derived earlier, deflated by the Consumer Price Index. This variable displays the expected negative sign, but is never statistically significant. More importantly, the remaining coefficients display considerable stability in the face of this modification, and so the conclusions of the earlier short-run analysis remain valid.

V POLICY IMPLICATIONS AND CONCLUSIONS

To recapitulate, the existence of non-wage costs of employment appears to exert a significant negative effect on the numbers employed in Irish manufacturing industry. The effect may indeed be somewhat greater than that suggested by this study as the index of non-wage costs used is narrowly based and includes only statutory costs. Other important components, such as training expenditures, benefits in kind, and payment for days not worked, could not be included, owing simply to lack of data. Preliminary results of the EEC Survey of Labour Costs in Industry, 1975, suggest that these omitted components are substantial in some industries, which must reinforce the policy implications of the results presented here.

Let us consider first the consequences of a reduction in the employer's statutory social insurance contributions, the major component of our non-wage ratio. Two aspects are of importance here: (1) the direct effects on employment and (2) the cost to the Exchequer. Let us suppose that there is a reduction of £1 per week in the employer's contribution. The point estimate from equations (1) and (3) of Table 1 suggests that at mid-1977 levels of non-wage costs and employment this would lead to the creation of 1,200 extra jobs in manufacturing industry. This is only the first-round effect; the multiplier effects in the non-manufacturing sector in subsequent periods would raise this figure somewhat. The direct cost to the Exchequer would be a weekly loss of some £200,000 in the manufacturing employers' contributions, but this would be to a certain extent offset by savings in unemployment compensation and by increased revenues from income tax. Very crude calculations[2] suggest, however, that in the absence of measures to recoup the revenue foregone, the costs to the Exchequer might not be insignificant. However, if the reduction in the employer's contributions were restricted only to new employees, the net cost to the Exchequer could actually be negative.

A further implication of the model advanced here is that measures to restrain the rate of growth in nominal incomes may have adverse effects on the volume of employment if they are not accompanied by similar measures to restrain the growth in the non-wage costs of employment. There are basically three strands to this argument. First, restraints on the growth of money incomes coupled with regular increases in fixed costs of employment may lead to a rise in the ratio of non-wage to wage costs and to a consequent fall in the level of employment. Secondly, trade union negotiators, faced with a centrally bargained norm, may seek further compensation through increases in holidays, sick pay provisions and other fringe benefits. From the

2. Assume two-thirds of the 1,200 newly employed were hitherto unemployed and in receipt of average unemployment benefit (UB) of £30 per week. The weekly saving in UB is, therefore, £24,000. If each newly employed person pays £10 a week income tax, the increased tax revenue will be £12,000 per week. Finally, the increased social insurance contributions yield is approximately £5,000 weekly. The total saving is £41,000 and the net weekly cost to the exchequer £160,000. This latter figure could be recouped by other measures which do not adversely effect the level of employment.

employer's point of view, each of these represents an increase in his non-wage costs and induces him to substitute increased hours for employment. Finally, the union negotiators may demand an increase in guaranteed overtime with a view to increasing their members' earnings while still remaining within the guidelines of the incomes policy or National Agreement. To the extent that they are successful, the level of employment must fall. If the foregoing analysis is correct, it would appear to further reduce the attractions of incomes policy as an instrument in a small open fixed exchange rate economy.

Finally, as noted earlier, the work of Oi (1962), Rosen (1968) and Soligo (1966) would suggest that as non-wage costs grow in importance, employment becomes less and less sensitive to variations in the level of output. It would seem that there is a trade-off involved here. The greater the importance of non-wage costs, the lower, but the more stable, the level of employment associated with a given volume of output. Thus in a recession, employment will hold up rather well. However, when output begins to increase again, no great recovery in employment can be expected. In itself, this may have destabilising consequences for the economy as a whole in the event of political attempts to stimulate employment in the run-up to an election. In the face of a high degree of fixity of the level of employment as a result of substantial non-wage costs, the effects of a fiscal stimulus will be manifested in earnings and price inflation, rather than in the numbers employed and unemployed.

These undesirable consequences of non-wage costs stem primarily from the manner in which such costs are levied, largely as flat-rate contributions. The restructuring of such changes on a fully proportional basis and the abolition of ceilings on contributions would essentially destroy the fixed element and thereby eliminate the induced incentive to substitute hours for employment.

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Appendix 1: *Ratio of non-wage costs to wage costs, 1969 – 1977*

Year	*Quarter*	$\frac{nw}{w_1}$
1969	03	.046
	04	.045
1970	01	.051
	02	.042
	03	.046
	04	.052
1971	01	.050
	02	.049
	03	.047
	04	.051
1972	01	.048
	02	.047
	03	.046
	04	.053
1973	01	.050
	02	.047
	03	.061
	04	.062
1974	01	.060
	02	.067
	03	.078
	04	.073
1975	01	.069
	02	.088
	03	.083
	04	.080
1976	01	.078
	02	.101
	03	.098
	04	.093
1977	01	.091
	02	.095

Appendix 2: *Regression results*

Equation No.	*Method of estimation*	*Dependent variable*	*Intercept*	Q_t	$\frac{Q_t}{Q_{t-1}}$	Q^*_t	N_{t-1}	$\frac{nw}{w_1}$	$\frac{N^*}{N_t}$	τ	*RW*	R^2	*DW*	*h*
(1)	Wallis	N_t	1.219			0.04	0.76	−0.04		0.0009	−0.04	0.99		0.42
						(1.51)	(7.05)	(−2.57)		(1.00)	(−0.91)			
(2)	CORC	H_t	7.108			−0.02		0.02	0.17	−0.0002	−0.06	0.87	1.46	
						(−0.96)		(1.43)	(3.65)	(−0.24)	(−1.86)			
(3)	Wallis	N_t	1.183	0.23	−0.09		0.59	−0.028		−0.02	−0.02	0.90		0.67
				(3.48)	(−1.36)		(5.11)	(−1.99)		(−1.41)	(−0.54)			
(4)	CORC	H_t	6.800	0.02	−0.03			0.01	0.39	−0.0004	−0.04	0.88	1.61	
				(0.44)	(−0.63)			(0.60)	(3.48)	(−0.41)	(−1.45)			

Notes
(1) Figures in parentheses are t- statistics.
(2) "h" is Durbin's (1970) test for autocorrelation when one of the regressors is a lagged dependent variable.
(3) CORC denotes Cochrane-Orcutt
(4) ρ is the sample autocorrelation coefficient.