NBER WORKING PAPER SERIES

REAL WAGE DETERMINATION IN COLLECTIVE BARGAINING AGREEMENTS

Louis N. Christofides

Andrew J. Oswald

Working Paper No. 3188

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 1989

The authors are grateful to C. Bean for helpful comments, to Sean Reynolds for computing and research assistance and to Nato, ESRC and SSHRC for financial assistance. The paper was read at the IEA World Congress in Athens, where helpful comments were received from L. Reichlin.

Readers who wish to obtain a data appendix or results not published in this paper should contact Louis N. Christofides, Department of Economics, University of Guelph, Guelph, Ontario, Canada N1G 2W1. The data itself is the property of the Bureau of Labor Information, Labor Canada, Ottawa, K1A 0J2. This paper is part of NBER's research program in Labor Studies. Any opinions expressed are those of the authors not those of the National Bureau of Economic Research.

NBER Working Paper #3188
November 1989

REAL WAGE DETERMINATION IN COLLECTIVE BARGAINING AGREEMENTS

ABSTRACT

This paper studies the determinants of real wage rates using data on Canadian labour contracts signed between 1978 and 1984. Its results are consistent with Dunlop's neglected (1944) hypothesis that real pay movements are shaped by product price changes (contrary to the predictions of implicit contract theory and other models of wage inflexibility). The level of the unemployment rate is found to lower the real wage level with an elasticity between -0.04 and -0.13, whereas a Phillips Curve specification which relates wage changes to the level of the unemployment rate is not convincingly supported by the data. These results may be seen as consistent with the view that collective bargaining is a form of rent-sharing in which external unemployment weakens workers' bargaining strength.

Louis N. Christofides
Department of Economics
University of Guelph
Guelph, Ontario
N1G 2W1
Canada

Andrew J. Oswald
Department of Economics
Rockefeller Center
Dartmouth College
Hanover, NH 03775

1. Introduction

The wage rate is often seen as one of the most important prices in the economy. It shapes the distribution of income, the levels of employment and unemployment, and the participation and effort decisions of individual workers. Despite its apparent significance, however, the wage determination process remains complex and controversial. Some ideas, such as the Phillips curve, have received extraordinary scrutiny. Other issues, such as wage rigidity theorems, hysteresis and the bargaining framework which determines wage/employment outcomes, have received little empirical attention.

This paper has two principal novel aspects. It studies the effects on real wages of (i) the level of unemployment and (ii) industry product prices. The conceptual framework underlying this approach is a bargaining analysis in which rents are divided between the firm and the trade union. High industry selling prices lead to a large surplus to be divided. High unemloyment acts to weaken workers' relative bargaining strength.

The empirical framework here differs from that of a conventional Phillips Curve model. In that approach, unemployment is seen as a measure of excess demand for labour, and a disequilibrium wage-adjustment mechanism is assumed. Empirically this framework works unpredictably. Our study considers instead the possibility that there is a long-run relationship between the wage level and the unemployment level. Although this is an idea going at least as far back as Sargan (1964), it has been largely ignored except by a small number of economists at the London School of Economics.

A related set of issues is the extent to which insider forces and hysteresis help shape the real wage rate. Given our empirical framework, these ideas can be readily examined.

Section 2 and the Appendix survey these theoretical issues and suggest the empirical framework that may be used to examine them. Section 3 reviews the data used, while Section 4 discusses our empirical findings. A summary and concluding observations appear in Section 5.

2. Theoretical Issues

The possible dependence of the rate of wage change on the level of unemployment, made famous by the work of Phillips (1958), was examined in an immense literature during the 1960s and 70s. By the middle of the 1980s, however, there was no consensus as to the role of unemployment in the wage determination process. Much of the early literature is surveyed in Laidler and Parkin (1975); more recent contributions include Christofides, Swidinsky and Wilton (1980), Beckerman and Jenkinson (1986) and Grubb (1986). Although some investigators have found evidence for a negative relationship between wage change and the level of unemployment, a plethora of results exists and faith in Phillips' original conception is diminished.

In part because of such dissatisfaction, a newer tradition has recently emerged. Work by Newell and Symons (1985), Layard and Nickell (1986), Nickell (1987), Carruth and Oswald (1987) and others at the London School of Economics has attempted to estimate a real wage level equation. The unemployment rate is taken as a key independent variable in this form of equation. According to this new approach, the unemployment rate is not a measure of excess demand or supply which affects the speed of wage adjustment during disequilibrium. Instead, it shapes the real wage in equilibrium by influencing the relative bargaining strength of firms and workers (or unions). For this reason, unemployment has a long run effect on

the level of real wages. A more complete formal statement of this approach is contained in the Appendix.

In a later section we examine empirically both the Phillips Curve and this, more recent, hypothesis on the role of unemployment. Previous work of this kind goes back to Sargan's (1964) pioneering study and includes Newell and Symons (1986), who study the roles of tax and price 'wedges' and nominal rigidity using UK data. In contrast, this paper estimates real wage change equations and focuses upon the issue of whether it is unemployment or its rate of change which enters such equations with a negative sign - see Vanderkamp (1972). Unlike Newell and Symons (1986), who use aggregate data, we rely on data drawn from individual wage agreements signed in the Canadian unionised sector between 1978-1984.

A second question of interest is whether wage rates are determined in part by product prices. To quote from a key, but routinely over-looked, passage in Dunlop (1944, p. 146),

> "...The central theme is that declines in product prices and not unemployment constitute the effective downward pressure on wage structures."

This idea contradicts the much more recent belief of wage rigidity in the face of sectoral price movements. Implicit contract theory (e.g., Baily (1974), Gordon (1974) and Azariadis (1975)), efficiency wage theory (e.g., Solow (1979), Shapiro and Stiglitz (1984), and Yellen (1984)) and some trade union models (e.g., McDonald and Solow (1981)) all bear upon the flexibility of pay in the face of product price changes. Wage rigidity theorems along such lines have become a routine part of modern economic theory. Yet not only do they differ radically from the beliefs of post-war labour economists, but they are also largely untested[1]. However, contract data

---

1 See, however, Brown (1982) and Martinello (1988).

allow the wage rigidity hypothesis to be evaluated in a straightforward way. The industry's price can be entered as an explanatory variable in a contract wage equation. In this context, simultaneity bias should be minimal because of the micro nature of the dependent variable and because some of the regressors are firm specific -- see Kennan (1988).

The analysis of so-called "insider-outsider" theories -- stressed recently by Solow (1985), Blanchard and Summers (1986), Gregory (1986), Lindbeck and Snower (1986) and Gottfries and Horn (1987), among others-- suggests that movements in wages are governed more by internal pressure than external pressure. In contrast to the theory of competitive labour markets, this branch of labour market theory implies that a firm's pay depends principally upon its own employment changes and product market characteristics. In this literature, aggregate unemployment has little or no effect on the real wage rate. Instead, it depends on lagged employment and demand shift variables[2].

The three strands of literature surveyed in this section can be investigated using the framework outlined in the Appendix. As indicated there, firms and unions are assumed to maximize the weighted product of their utilities above their fallback positions with respect to employment and the wage rate. This process results in an equation for the wage rate which depends on the alternative wage rate, union membership, the average

---

[2] Blanchard and Summers (1986, p.43) write "...it seems reasonable to expect that a reduction in the number of incumbent workers will lead to the setting of higher wage..." while Solow (1985, p.347) states "...insiders ...convert higher demand into higher wages for themselves rather than into increased access to jobs for outsiders."

price of competing firm goods, a demand shock variable, firm fixed costs and the consumer price index. The alternative wage rate in turn depends on the prevailing regional wage, unemployment insurance benefits and their duration as well as the unemployment rate itself.

The wage equation can be estimated in either real or nominal form. Early work on Phillips Curves assumed that nominal wage change depends upon the unemployment level. Later variants added the nominal rate of change of prices as another independent variable -- thereby converting to the assumption that real wage change depends upon the unemployment level. The approach outlined in the Appendix assumes instead that the real wage level is a function of the level of unemployment. Section 4 contrasts this approach with that of the standard (inflation adjusted) Phillips Curve. For this reason the regression equations below take the real wage, rather than the nominal wage, as the variable to be explained. To control for unobservable contract - specific fixed effects, the equations are estimated in changes.

3. The Data

Much of the North-American work on Phillips Curves uses micro, contract-based, data rather than the more standard aggregate time series variables. This approach, which originates with Hamermesh (1970), has advantages, particularly in the present context where bargaining considerations are assumed to drive microeconomic agents. Wage agreement data reflect, as closely as can be hoped, the theory outlined in the Appendix. There appear to be no published studies using this Canadian information in the context of bargaining models. The equations reported

below link the extensive microeconometric literature on the Phillips Curve, which works with rates of change of nominal wage variables, to the London School of Economics literature that deals with real wage level equations.

The data used in this study were made available to us by Labour Canada and are drawn from contracts reached between 420 establishments and 68 unions in a wide variety of Canadian industries[3]. These contracts involve 500 or more employees and were arrived at in the private, non-controlled[4], sector between 1978Q1 and 1984Q4. The data tape contains information on 1015 contracts. A number of variables are reported for each agreement. These include the effective and expiry dates of the current and previous contract, the number of employees at the beginning of the current and past contracts, the nominal base wage rate at the end of the previous agreement as well as the total non-contingent wage increase implemented during the current contract. It is, therefore, possible to measure the real wage rate both at the end of the previous and at the beginning of the current

---

[3] These include Mining, Logging, several aspects of Manufacturing, Trade and Services. Data on the construction industry are not available prior to 1983 and are not included in this sample.

[4] During 1982Q3 to 1983Q4, a number of federal and provincial programmes attempted to regulate pay in the public and para-public (i.e. Education, Health, Federal and Provincial Administration and parts of Transportation, Communications and Utilities) sectors. All agreements subject to such controls were excluded from the present sample by Labour Canada. Nevertheless, these programmes may have had an impact on wage determination in the private sector, a possibility which is considered in section 4.

agreement. The Consumer Price Index is included in the original data and has a base of 1971 = 100. This is used both to deflate nominal magnitudes and as variable c in the Appendix. Real wage rates evaluated at the end of the previous contract are denoted by (-1). Industry product price indices were obtained from the 1986 Cansim tape and were appended to the contract data - they set 1981 = 100. The demand shift variable (z) was proxied by real industry GDP[5]. A federal controls dummy variable is also contained in the original Labour Canada tape.

In order to implement the discussion of section 2 and the Appendix, it is necessary to specify the ingredients of the alternative wage rate (ω). This is assumed to be a function of the regional wage rate (r), defined as average weekly earnings in the same province and SIC classification, the statutory amount of unemployment insurance available to a worker in the region and year, the statutory duration of that benefit level and the regional unemployment rate[6]. The regional unemployment rates used are contained in the original Labour Canada tape.

---

[5] To each contract was assigned the real GDP (1971 dollars) generated in the same industry (ten industries are distinguished) in the year in which the previous contract became effective. Source: Economic Review, Ottawa, Department of Finance, 1985.

[6] The average weekly earnings data is available from the Cansim tape. The unemployment insurance benefit and duration data were obtained from Unemployment Insurance, Ottawa: Employment and Immigration, September 1985. The benefits and duration of benefits in the province and year of the unit's previous agreement were assigned to each contract.

Before proceeding to specify empirical versions of equation (A.7), certain issues peculiar to contract data must be dealt with. Wage agreements reached in Canada and North-America generally last for long periods of time, entail a small number of nominal wage revisions which tend to be front-loaded and have no, or limited, cost-of-living allowance clauses. For these reasons the real wage rate can be expected to be at its highest at the beginning of a contract because that is when most nominal wage adjustment occurs. The magnitude of this saw-tooth effect in the real wage rate depends on the degree of indexation built into a contract and the expected inflation rate over the life of the contract. The greater the elasticity of indexation, the smaller the need to front-load wage increases. For a given number of wage revisions[7], the longer the contract's duration and the greater the expected annual inflation rate, the greater the need to set a high real wage rate at the start of a contract. Given that the real wage rate variable on the data tape is measured at the beginning of the contract, it is necessary to augment equation (A.7) to take account of these issues. Thus the average ex-ante elasticity of indexation over the current contract, the length of the contract itself and the expected annual inflation rate are included in our empirical equations below. These variables are part of the original Labour Canada tape. The coefficients on the expected annual inflation rate and contract duration should be positive, while that on the elasticity of indexation should be negative.

---

[7] No information on this variable is available in this particular sample otherwise this would have been a useful additional regressor with an expected negative coefficient. See Christofides (1982) for further discussion of this issue.

Descriptive statistics on the main variables are reported in Table 1.

4. Empirical Results

Tables 2 and 3 report our empirical results. In order to deal with possible fixed effects, contract-to-contract time differences in the logarithms of most variables were used. Of the original 1015 records on the Labour Canada tape many were lost in the differencing. Several records were first contracts and these were, therefore, lost. Nevertheless, a large sample of 595 observations remained. Tables 2 and 3 retain a constant term in order to allow for possible trends in the level equations. Similar results were obtained when constants were excluded[8].

Column 1, Table 2, reports an equation corresponding to equation (A.7) in the Appendix. As Dunlop (1944) would have predicted, industry prices and GDP have positive signs and are statistically significant at the 5% level. This is consistent with the hypothesis that workers share in product market prosperity.

The regional unemployment rate is also statistically significant at the 5% level and has an elasticity of -0.069. We interpret this as an unemployment effect on workers bargaining strength. When outside opportunities worsen, workers wages inside the firm are depressed.

---

8 To the extent that the error terms in the level equations are white noise, the error terms in the change equations are MA(1) and some efficiency gains remain unexploited. Realizing these gains is bedevilled by the unbalanced nature of the sample which results from varying contract lengths. Some preliminary work suggests that the MA(1) structure appears to be weak.

The variable which indicates the presence of wage controls in public sector contracts signed between 1982Q3-1984Q2 is significant, suggesting small effects on private sector wage agreements. The regional wage rate (r) is statistically significant at the 5% level and has an elasticity of 0.133. However, the signs on the UI benefit variables are somewhat puzzling; it is conceivable that this is because of multicollinearity with regional unemployment[9]. This argument is consistent with the results reported in column 2, Table 2. When the benefit variables are dropped, the coefficient and t statistic on the regional unemployment rate increase substantially in absolute size. Column 3, Table 2, introduces the variables discussed on p. 8 above. The elasticity of indexation, contract duration and the expected inflation rate all have the expected signs, sizeable coefficients and are statistically significant at the 5% level. The real wage rate prevailing at the end of the previous contract has the expected sign and is significant at the 5% level, but its effect is small. The addition of these "accounting" variables and the past real wage rate improves considerably the fit of the equation: the adjusted $\bar{R}^2$ jumps from 0.476 in column 1 to 0.708 in column 3, Table 2. Given the cross-sectional nature of much of the data, this is a satisfactory fit. Column 3, Table 2 shows that the significance of the industry GDP variable is substantially reduced; the coefficients on and the

---

[9] The simple correlation coefficients between the change in the logarithms of UI Benefits, UI Benefit Duration and the regional unemployment rate are 0.13 and 0.78 respectively. We chose not to combine the statutory information on unemployment insurance variables into a single variable in order to avoid imposing a constraint.

statistical significance of other variables are not substantially affected[10].

Columns 4 and 5, Table 2, begin an exploration of the issue of whether it is the change or the level of the regional unemployment rate that affects real wage change. It is clear that the level does not perform nearly as well as the change in the regional unemployment rate, a fact which is inconsistent with the standard Phillips curve model. Column 5, Table 2 confirms the effects of multicollinearity between the benefit and unemployment rate variables: relative to column 4, Table 2, the change in the unemployment rate variable has a smaller coefficient and a substantially reduced t value.

The comparison between the Phillips curve specification and specifications based on equation (A.7) is continued in Table 3. This table specifies equations which, given the nature of the dependent variable, approximate as closely as possible equations estimated in the Phillips curve literature. These equations include spillover variables which may be proxied by the regional wage rate. The CPI is included in order not to exclude the possibility of some degree of money illusion; it also short-circuits the formation of inflationary expectations. Controls variables are, of course, standard in the Phillips curve approach. The current accounting variables are included in order to better specify the real wage equations. It is clear that the change-on-level specification produces

---

10 To the extent that our industry product price variable measures the average industry product price with an error, the estimated coefficients underestimate the true ones.

coefficients[11] and t ratios which sit reasonably well with the Phillips curve approach. However, there is no doubt that these specifications are dominated by the change-on-change equations of columns 2 and 5, Table 3. This is confirmed in the encompassing equations of the same table. It is noteworthy, however, that the equations in Table 3 are not as successful as those of Table 2.

Returning to the latter, columns 6 and 7 check on some implications of the insider/outsider literature. The change in the logarithm of the lagged employment variable[12] is not statistically significant, and has a positive sign -- contrary to the expectation of Blanchard and Summers (1986). In addition, the exclusion of the unemployment variables damages the overall goodness of fit. This is to be expected, of course, given the consistently useful role played by the change in the unemployment rate variable.

The final column of Table 2 omits the variables which proxy the impact of the business cycle on firms in particular industries[13] . The product price variable is particularly robust and statistically significant at the 5% level and its omission is clearly inappropriate. Dunlop's (1944) hypothesis thus appears to be consistent with these results, though the results also suggest a role for unemployment. These findings may also be

---

[11] These are -0.015 (2.14) and -0.070 (7.42) in columns 1 and 4, Table 3 respectively.

[12] Note that simultaneity is avoided by use of the employment level at the beginning of the previous contract.

[13] It also omits the irrelevant employment variable. A similar equation which omits just DL Ind. Prices confirmed the inadvisability of dropping what is clearly an important variable.

consistent with the ideas proposed in Solow (1985). However, the estimated equations do not favour the wage rigidity predictions discussed earlier.

Tables 2 and 3 were re-estimated using the regional unemployment rate prevailing during the quarter in which an agreement became effective- rather than the rate prevailing during the quarter in which the previous agreement expired. The results obtained were similar to those discussed above and are, therefore, not reported. Several other variables, which proved to be not terribly useful, were also considered. These include the industrial relations stage at which an agreement was reached, the size of the union and a dummy variable which assumed the value of unity for unions which signed more than arbitrary numbers of contracts.

5. Conclusion

This paper has attempted to uncover the factors which shape the behaviour of real wage rates. It uses a sample of labour contracts signed in the unionized sector of the Canadian economy between 1978 and 1984, and merges this with extra information on the employing firms' industries and regions.

There are three principal conclusions. First, the real wage rate at the microeconomic level is inversely related to the unemployment rate in the employer's region. Estimates of the unemployment elasticity of wages ranged between -0.04 and -0.13. Only limited support was found for the traditional approach in which wage changes depend upon the unemployment level; it appears that the level of the real wage rate depends more strongly and reliably upon the level of the unemployment rate. Second, there is strong evidence in favour of Dunlop's (1944) hypothesis that real wage

movements are sensitive to real product price changes[14]. This is consistent with recent ideas (eg. Solow (1985)) concerning how 'insiders' convert demand shocks into higher pay, but is inconsistent with the wage rigidity proposition of implicit contract theory and of other models of pay inflexibility. Third, current contract wages do not appear to depend negatively upon the level of employment in the previous contract. If anything, this relationship was weakly positive.

These results are consistent with the view that collective bargaining may be seen as a process of rent-sharing. When an industry has high selling prices, its workers benefit in the form of higher real earnings. High unemployment in the outside labour market, however, acts to weaken workers' bargaining power. The greater the unemployment rate, the lower the real wage.

---

[14] New work, on British panel data, by Nickell and Wadhwani (1987) also identifies a product price effect, although the authors interpret it somewhat differently. Carruth, Oswald and Findlay (1986) report a real wage equation for steelworkers in which the steel price enters significantly.

Appendix

Monopolistic competition is assumed to prevail. Risk-neutral firms maximize the profit function

$$\pi = R(n,p,c,z)-wn-k \tag{A.1}$$

where $R(n,p,c,z)$ measures nominal firm revenue, n is employment, c is the consumer price index, p is the average price of other competitors' goods (differentiated products), z is a demand shock variable, w is the nominal wage rate and k is fixed costs. Unions maximize the utility function

$$V = V(w,n,m,\omega,c) \tag{A.2}$$

where m is the union membership and ω is some alternative or outside nominal wage rate. The inclusion of others' levels of pay, summarized by the ω variable, may be justified in a number of ways. To begin with, ω may be the wage available to members of the union who are unable to obtain jobs within the firm. Second, ω may influence the utility of employed union members through a wage parity or 'jealousy' effect. These have different implications for the sign of the partial derivative of equation (A.2). The first suggests that $V(.)$ will be increasing in ω, the second that it will be decreasing in ω. Finally, the consumer price level, c, enters equation (A.2) to ensure the absence of money illusion. Equation (A.2) nests most of the union utility functions considered in the literature, including the original wage bill maximand of Dunlop (1944). Survey discussions of these issues are available in Oswald (1985) and Pencavel (1985).

The alternative or outside wage, ω, may itself depend upon a number of variables. It is assumed that it can be written as

$$\omega = \omega(r, b, d, U) \tag{A.3}$$

in which r is the regional wage rate, b is the unemployment benefit, d is

the duration of the unemployment benefit and U is the unemployment rate in the region. Hence ω is to be thought of as a function of the level of pay in the firm's own geographical area, and also of the level of income if jobs cannot be found, namely of the unemployment benefit level. The probability of finding work at rate r, rather than being unemployed at rate b, depends upon the prevailing unemployment rate U.

It is convenient to follow the common practice of assuming that bargaining can be modelled using the Nash (1953) solution. This can be given an axiomatic justification or may be justified by appealing to a non-cooperative game theoretic framework, in which the two sides are allowed to make alternating offers - see Binmore, Rubinstein and Wolinsky (1986).

Assume that wages and employment are chosen to solve the problem:

$$\text{Maximize} \quad (V - \hat{V})^{\gamma}(\pi - \hat{\pi})^{1-\gamma} \tag{A.4}$$

in which $\hat{V}$ and $\hat{\pi}$ are, respectively, the union's utility and the firm's utility in the event of a delay in settlement. The constant γ is assumed to lie between zero and unity. In fact γ may itself be a function of other variables; it may, for instance, depend on whether wage controls are in place -- the possibility that incomes policy affects the real wage is explored in the empirical section.

If there is a breakdown in negotiations, the two agents receive only their delay utilities (denoted by a $\hat{}$). Bargaining power stems from the ability to enjoy a relatively large delay utility. In the case of the firm it is assumed that

$$\hat{\pi} = -k , \tag{A.5}$$

namely, that during a disagreement the firm receives no revenue, and has no labour costs to pay, but must cover its fixed costs. The union's members

may find work temporarily during a stoppage. Therefore it is assumed that

$$\hat{V} = \hat{V}(r, n, b, m, U, c) \quad . \qquad (A.6)$$

Employees are not paid a wage by the firm during a dispute but may find work at pay level r. Unemployment, U, affects the probability of workers doing so. It is plausible to assume that $\hat{V}$ is a declining function of U. On this view, workers' bargaining ability is weakened by outside unemployment.

The Nash bargaining problem then maximizes expression (A.4) using equations (A.1), (A.2), (A.3), (A.5) and (A.6). The solution lies upon the contract curve defined by the locus of tangencies between employer and employee preferences. Using w^* to denote the wage outcome, equilibrium is given by the function

$$w^* = w^*(r, b, U, c, m, p, z, k) \quad . \qquad (A.7)$$

This is almost identical to the wage equation of a monopoly union model the difference being that in a bargaining context fixed costs, k, matter because they influence the firm's utility in the event of a breakdown in negotiations.

Equation (A.7) can be rewritten in real terms by deflating by the consumer price index, c. If nominal prices have no effect, i.e. there is no money-illusion, the variable c will drop out of the right hand side of the equation.

TABLE 1

Descriptive Statistics[1]

	Mean	St.Dev.
Nominal wage rate (-1)[2]	9.15	2.64
Nominal wage rate[2]	10.54	2.74
Product Price Index[3]	102.72	11.47
Industry GDP[4]	13315.65	4689.34
Nominal regional wage rate	397.60	97.32
Regional UI Benefit[5]	142.43	17.99
Regional Benefit Duration[6]	21.93	4.17
Regional Unempl. Rate	10.11	2.91
Employment (-1)	1522.36	2274.39
Elast. of Indexation	0.11	0.30
Elast. of Index.(-1)	0.12	0.30
Contract Duration[7]	25.61	7.76
Contract Duration (-1)	23.79	7.41
Exp. Inflation[8]	6.86	2.92
Infl. Surprise[8]	0.06	1.90

1. Based on 595 observations from all regions and years.
2. Base wage rate in dollars per hour.
3. 1981 equals 100.
4. In 1971 dollars; ten industries are distinguished.
5. In dollars per week.
6. In weeks.
7. In months.
8. Percent, annual rates.

Δ L Real Wage Rate Equations

(|t| statistics in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	0.071*	0.069*	0.003	0.014	0.021	0.021	0.008	0.025
	(9.30)	(9.12)	(0.39)	(0.86)	(1.21)	(1.19)	(1.32)	(1.46)
ΔL Ind. Prices	0.086*	0.161*	0.084*	0.083*	0.084*	0.080*	0.090*	
	(2.18)	(4.08)	(2.76)	(2.73)	(2.73)	(2.60)	(2.90)	
ΔL CPI	-0.409*	-0.407*	0.024	0.025	0.021	0.023	0.010	0.100*
	(-7.74)	(7.42)	(.534)	(.569)	(.453)	(.506)	(.211)	(2.85)
ΔL Ind. GDP	0.235*	0.330*	0.056	0.051	0.036	0.032	-0.002	
	(4.75)	(6.90)	(1.48)	(1.34)	(0.91)	(0.81)	(0.06)	
ΔL Reg. Wage	0.133*	0.048	0.105*	0.102*	0.104*	0.103*	0.116*	0.091*
	(2.23)	(0.80)	(2.40)	(2.32)	(2.32)	(2.30)	(2.59)	(2.05)
ΔL Reg. UI Ben.	-0.370*				-0.016	-0.014	-0.012	-0.031
	(5.68)				(0.28)	(0.25)	(0.21)	(0.56)
ΔL Reg. UI Dur.	-0.088*				-0.034	-0.036	-0.083*	-0.038
	(3.16)				(1.49)	(1.57)	(4.84)	(1.67)
Δ Controls	-0.014*	-0.010	-0.007	-0.007	-0.009*	-0.009*	-0.015*	-0.009*
	(2.65)	(1.88)	(1.82)	(1.79)	(2.15)	(2.19)	(4.13)	(2.23)
L Reg. Unempl.				-0.006	-0.008	-0.007		-0.010
				(0.77)	(1.05)	(1.01)		(1.34)
ΔL Reg. Unempl.	-0.069*	-0.117*	-0.056*	-0.054*	-0.041*	-0.040*		-0.040*
	(4.14)	(10.29)	(5.84)	(5.50)	(3.03)	(2.98)		(3.15)
ΔL Empl. (-1)						0.009	0.011	
						(1.21)	(1.40)	
ΔL Real Wage (-1)			0.082*	0.081*	0.098*	0.100*	0.119*	0.094*
			(2.26)	(2.25)	(2.59)	(2.62)	(3.17)	(2.48)
Δ Elast.			-0.091*	-0.092*	-0.091*	-0.090*	-0.093*	-0.091
			(6.23)	(6.27)	(6.24)	(6.16)	(6.33)	(6.29)
ΔL Duration			0.120*	0.120*	0.119*	0.119*	0.119*	0.119*
			(20.41)	(20.40)	(19.89)	(19.86)	(19.62)	(19.94)
ΔL Expected Infl.			0.059*	0.058*	0.054*	0.054*	0.062*	0.060*
			(9.35)	(8.89)	(7.32)	(7.34)	(8.89)	(8.28)
SEE	0.056	0.059	0.042	0.042	0.042	0.042	0.042	0.042
R^2	0.476	0.434	0.708	0.708	0.708	0.708	0.704	0.705

Note: ΔL denotes a logarithmic difference

* Indicates significance at the 5% level.

TABLE 3

ΔL Real Wage Rate Equations: Comparison of Phillips and Bargaining Specifications

(|t| statistics in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.045*	-0.004	0.021	0.208*	0.044*	0.118*
	(2.71)	(0.76)	(1.26)	(9.41)	(6.38)	(5.16)
ΔL CPI	0.054	0.097*	0.096*	-0.220*	-0.114*	-0.131*
	(1.75)	(3.13)	(3.07)	(5.37)	(2.89)	(3.31)
ΔL Reg. Wage	0.115*	0.098*	0.094*			
	(2.55)	(2.23)	(2.14)			
Δ Controls	-0.015*	-0.006	-0.006	-0.036*	-0.011*	-0.010
	(4.15)	(1.60)	(1.58)	(7.20)	(2.04)	(1.80)
L Reg. Unempl.	-0.015*		-0.008	-0.070*		-0.033*
	(2.14)		(1.06)	(7.42)		(3.40)
ΔL Reg. Unempl.		-0.053*	-0.053*		-0.132*	-0.114*
		(5.82)	(5.50)		(11.54)	(9.18)
Δ Elast.	-0.102*	-0.094*	-0.094*			
	(6.87)	(6.44)	(6.47)			
ΔL Duration	0.120*	0.120*	0.120*			
	(20.04)	(20.53)	(20.56)			
ΔL Infl. Exp.	0.072*	0.061*	0.059*			
	(14.29)	(12.01)	(10.85)			
SEE	0.043	0.042	0.042	0.065	0.062	0.061
$\bar{R}^2$	0.688	0.703	0.703	0.295	0.371	0.382

* significant at 5% level.

References

Azariadis, Costas

1975 "Implicit Contracts and Underemployment Equilibrium." Journal of Political Economy, Vol. 83, pp. 1183-1202.

Baily, Martin N.

1974 "Wages and Employment under Uncertain Demand." Review of Economic Studies, Vol. 41, pp. 37-50.

Beckerman, Wilfred and Tim Jenkinson

1986 "What Stopped the Inflation: Unemployment or Commodity Prices?" Economic Journal, Vol. 96, pp. 39-54.

Binmore, Ken, Ariel Rubinstein and Asher Wolinsky

1986 "The Nash Bargaining Solution in Economic Modelling." Rand Journal of Economics, Vol.17, pp. 176-188.

Blanchard, Olivier J. and Lawrence H. Summers

1986 "Hysteresis and the European Unemployment Problem." NBER Macro-economics Annual, Cambridge, MIT Press.

Brown, James N.

1982 "How Close To An Auction Is The Labour Market?" Research on Labor Economics, 5, pp. 182-235.

Carruth, Alan A. and Andrew J. Oswald

1987 "Wage Inflexibility in Britain." Oxford Bulletin of Economics and Statistics, Vol. 49, pp. 59-78.

Carruth, Alan A., Andrew J. Oswald and Lewis Findlay

1986 "A Test of a Model of Trade Union Behaviour: The Coal and Steel Industries in Britain." Oxford Bulletin of Economics and Statistics, Vol. 48, pp. 1-18.

Christofides, Louis N.

1982 "Expected Inflation and the Optimal Number of Nominal Wage Rate Revisions." Economics Letters, Vol. 9, pp. 243-249.

Christofides, Louis N., Robert Swidinsky and David Wilton

1980 "A Microeconometric Analysis of the Canadian Wage Determination Process." Economica, Vol. 47, pp. 165-178.

Dunlop, John

1944 Wage Determination Under Trade Unions. New York: MacMillan.

Gordon, Donald F.

1974 "A Neoclassical Theory of Keynesian Unemployment." Economic Inquiry, Vol. 12, pp. 431-459.

Gottfries, Nils and Henrik Horn

1987 "Wage Formation and the Persistence of Unemployment." Economic

Journal, Vol. 97, pp. 877-884.

Gregory, Robert G.

1986 "Wages Policy and Unemployment in Australia." Economica, Vol. 53, pp. 553-574.

Grubb, David

1986 "Topics in the OECD Phillips Curve." Economic Journal, Vol. 96, pp. 55-79.

Hamermesh, Daniel

1970 "Wage Bargains, Threshold Effects and the Phillips Curve." Quarterly Journal of Economics, Vol. 84, pp. 501-517.

Kennan, John

1988 "Simultaneous Equations Bias in Disaggregated Econometric Models." Working paper, University of Iowa, May.

Laidler, David and Michael J. Parkin

1975 "Inflation: A Survey." Economic Journal, Vol. 85, pp. 741-809.

Layard, Richard and Steven Nickell

1986 "Unemployment in Britain." Economica, Vol. 53, pp. S121-S170.

Lindbeck, Assar and Dennis Snower

1986 "Wage-Setting, Unemployment and Insider-Outsider Relations', American

Economic Review, Papers and Proceedings, Vol. 76, pp. 235-239.

Martinello, Felice

1988 "Insurance In A Unionised Labour Market: An Empirical Test", Canadian Journal of Economics, XXI, No. 2, May, pp. 394-409.

McDonald, Ian M. and Robert Solow

1981 "Wage Bargaining and Employment." American Economic Review, Vol. 71, pp. 896-908.

Nash, John

1953 "Two-Person Cooperative Games." Econometrica, Vol. 21, pp. 128-140.

Newell, Andrew and James Symons

1985 "Wages and Employment in the OECD Countries." Discussion Paper 219, Centre for Labour Economics, London School of Economics.

Newell, Andrew and James Symons

1986 "The Phillips Curve is a Real Wage Equation." Discussion Paper No. 86-16, Department of Economics, University College, London.

Nickell, Steven J.

1987 "Why is Wage Inflation in Britain So High?" Oxford Bulletin of Economics and Statistics, Vol. 49, pp. 103-128.

Nickell, Steven J. and Sushil Wadhwani

1987 "Insider Forces and Wage Determination." Working paper, University of Oxford.

Oswald, Andrew J.

1985 "The Economic Theory of Trade Unions: An Introductory Survey." Scandinavian Journal of Economics, Vol. 87, pp. 160-193.

Pencavel, John H.

1985 "Wages and Employment under Trade Unionism: Microeconomic Models and Macroeconomic Applications." Scandinavian Journal of Economics, Vol. 87, pp. 197-225.

Phillips, A. William

1958 "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957." Economica, Vol. 25, pp. 283-299.

Sargan, J. Denis

1964 "Wages and Prices in the United Kingdom: A Study in Econometric Methodology." Reprinted in David Hendry and Ken Wallis, eds., Econometrics and Quantitative Economics Oxford: Basil Blackwell, 1984, pp. 275-371.

Shapiro, Carl and Stiglitz, Joseph E.

1984 "Equilibrium Unemployment as a Discipline Device." American Economic Review, Vol. 73, pp. 433-444.

Solow, Robert M.

1979 "Another Possible Source of Wage Stickiness." Journal of Macroeconomics, Vol. 1, pp. 79-82.

Solow, Robert M.

1985 "Insiders and Outsiders in Wage Determination." Scandinavian Journal of Economics, Vol. 87, pp. 411-428.

Vanderkamp, John

1972 "Wage Adjustment, Productivity and Price Change Expectations." Review of Economic Studies, Vol. 39, pp. 61-72.

Yellen, Janet L.

1984 "Efficiency Wage Models of Unemployment." American Economic Review, Papers and Proceedings, Vol. 74, pp. 200-205.