OECD Economics Department Working Papers No. 19

Nominal Wage Determination in Ten OECD Economies

David T. Coe,

Francesco Gagliardi

https://dx.doi.org/10.1787/543148520161

OECD

OECD
ECONOMICS AND STATISTICS DEPARTMENT

WORKING PAPERS

No. 19: NOMINAL WAGE DETERMINATION IN TEN OECD ECONOMIES

by

David T. Coe
Francesco Gagliardi

General Economics Division

March 1985

OCDE OECD

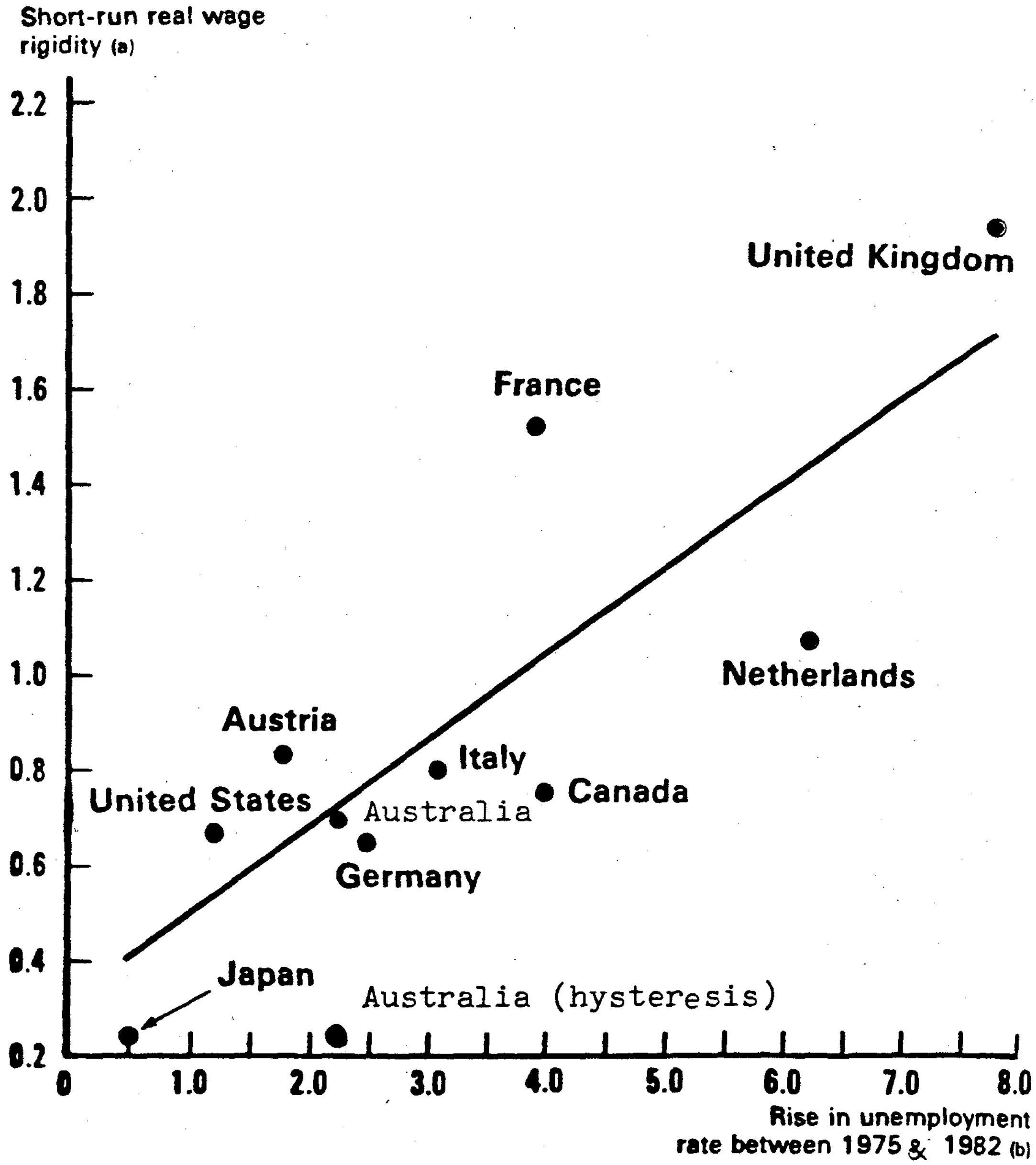
Corrigendum to OECD/ESD Working Paper No. 19:

NOMINAL WAGE DETERMINATION IN TEN OECD ECONOMIES

The average unemployment rate for the Netherlands from 1969-82 was incorrectly reported in the penultimate line of Table 12 (p.33). The correct figure is 5.1 (not 9.7). The correct figures in columns 3, 4, 5 and 7 of the same line are 0.44, 1.07, 2.14 and 3.21. Figure B is modified as follows:

Figure B

SHORT-RUN REAL WAGE RIGIDITY AND UNEMPLOYMENT



a) As given in column 4 of Table 12; for Japan, Germany, Austria & the Netherlands, the average unemployment rate over the estimation period has been used.
b) Percentage points.

GENERAL DISTRIBUTION

ECONOMICS AND STATISTICS DEPARTMENT

WORKING PAPERS

This series of Working Papers is designed to make available, to a wider readership, selected studies which the Department has prepared for use within OECD. Authorship is generally collective, but main individual authors are named. The Papers are available both in English and French.

Comment on the Papers is invited, and may be sent to OECD, Department of Economics and Statistics, 2 rue André-Pascal, 75775 Paris Cedex 16, France. Additional copies of the Papers on a limited basis can be forwarded on request.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

27690

NOMINAL WAGE DETERMINATION IN TEN OECD ECONOMIES

by

David T. Coe
Francesco Gagliardi

General Economics Division*

* Respectively Principal Administrator and Consultant/Trainee in the General Economics Division. The views expressed are those of the authors and do not necessarily represent the opinions of the OECD or its Member governments. The authors have benefitted from many helpful discussions with Mr. Gerald Holtham, Head of the General Economics Division.

CONTENTS

TABLES

NOMINAL WAGE DETERMINATION IN TEN OECD ECONOMIES

I. INTRODUCTION

1. The importance of wages in the analysis and forecasting of macroeconomic developments needs no emphasis. Nominal wage inflation is a crucial component of price inflation, while real wages importantly influence the demand for labour and for other factors of production. More generally, the way in which nominal wages are set is an important determinant of whether or not there is any short- or longer-run trade off between inflation and employment. The way that wages evolve in the current situation of recovering output and profits, where inflation has declined and unemployment remains high, will be critical in determining whether there are pressures which might contribute to a resurgence of inflation. This paper analyses the historical determinants of nominal wages in ten OECD economies and considers the implications for future wage, and hence inflation, developments.

2. The Phillips curve represents a dynamic adjustment process of nominal wages to equilibrium and disequilibrium phenomena (1). Labour market equilibrium is generally considered to be at the "natural rate of unemployment" which, according to Friedman (1968), is "the level that would be ground out by the Walrasian system of general equilibrium equations...". Typically, the labour market is not in equilibrium and nominal wage changes will reflect this disequilibrium as well as equilibrium elements such as the steady-state growth of trend productivity and past or expected rates of inflation. Although it is generally assumed that the labour market, like other markets, tends in the long run to equilibrium, in the short run, labour markets are sensitive to economic policies which accommodate or do not accommodate inflation. Consequently the Phillips curve plays a central role in the dynamic transformation of an economy from an inflationary to a less-inflationary regime, and vice-versa.

3. Given the importance of nominal wages, there are a large number of unresolved issues about how best to characterise the wage determination process. Section II of this paper investigates a number of these specification issues. The questions addressed include the role in aggregate wage formation of taxes, profits and previous shortfalls in real wages below trend, the linearity or non-linearity of the short-run Phillips curve, indexation and the specification of expectations, and the existence of "speed limits" to growth. Section III presents the results of testing the preferred equations for stability, thereby addressing the question of possible structural changes leading to "wage moderation". Section IV discusses the implications of the preferred equations for inflation prospects and draws out

cross-country comparisons in a discussion of specific measures of real and nominal wage flexibility.

4. Subsidiary motivation for this work is to improve the wage block in the INTERLINK model, which is used by the Secretariat for simulation analysis as well as forecasting. This has implied a number of constraints on the analysis: data are semi-annual macroeconomic aggregates and independent variables must be endogenous to the model or policy instruments. This means that the data used are not necessarily the most appropriate to test some of the specific hypotheses. In particular, except for the United States and Japan, the dependent variable is the private sector national accounts wage bill per employee, i.e. it is average yearly earnings, whereas hourly wages might be more appropriate for some purposes. Similarly, aggregate national accounts measures of productivity, consumer prices and taxes are used (an appendix gives information on data sources, etc.).

II. SPECIFICATION ISSUES AND ESTIMATION RESULTS

A. An overview of estimation results

5. The actual process underlying the Phillips curve whereby wages react to the disequilibrium and equilibrium elements referred to above is generally not specified. Nominal wages may be determined through atomistic trading in unorganised or dispersed labour markets, some of which might be characterised by implicit contracts; or through a more or less centralised bargaining process between the representatives of labour and employers. In either case, the settlements typically specify the nominal wage but not the real wage and very seldom the level of employment. Resulting changes in unemployment then strengthen or weaken the negotiating position of employers and workers, or their representatives, in subsequent rounds of bargaining. A general formulation of the short-run Phillips curve, applicable to a variety of institutional arrangements, relates the rate of change of wages (w) to a measure of past or expected consumer price inflation (pe), the unemployment rate (U) and a vector of other relevant variables (X):

$$w_t = a0 + a1.pe_t - a2.U_t + a3.X_t. \qquad [1]$$

The disequilibrium component of equation [1] is represented by the unemployment rate, which serves as a proxy for excess demand in the labour market; the equilibrium component is the constant, which might represent, in part, trend productivity, and the inflation term. Relevant variables included in X might be derived from alternative theories of wage determination or represent country-specific influences on nominal wage growth.

6. Estimates of this basic equation, or a non-linear version of it, are given in Table 1. The particular specifications of the activity variable and the inflation term anticipate results discussed below. The basic equations, with the exception of Australia, perform well based on the standard criteria, i.e. coefficient estimates are well determined, correctly signed and explain a large part of the variance in wage inflation. The estimates are based on semi-annual observations, usually from about the mid-1960s to the early 1980s. Given the simultaneous determination of wages and prices, all

Table 1

THE BASIC AUGMENTED PHILLIPS CURVE (a)

	Constant	Unemployment rate (U)		Inflation term (b)	SEE	DW	$\bar{R}^2$	Fit period
		U	log U					
United States	2.58 (12.1)	-0.33 (5.1)		1.01 (10.8)	0.24	1.74	0.90	65I - 83I
Japan	5.98 (8.9)		-6.24 (8.2)	0.89 (8.3)	1.06	1.94	0.90	68I - 83I
Germany (c)	2.81 (5.4)		-0.99 (4.3)	0.60 (2.5)	1.09	2.00	0.56	64I - 83I
	0.88 (1.1)		-0.68 (3.5)	0.88 (3.9)	0.93	2.43	0.69	64I - 83I
France	2.36 (8.1)	-0.31 (3.8)		0.94 (6.9)	0.69	1.93	0.85	64II- 83I
United Kingdom	2.13 (3.6)	-0.17 (1.9)		0.99 (9.3)	1.46	1.72	0.77	65I - 83I
Italy	5.63 (5.5)	-0.55 (2.7)		0.89 (7.4)	1.79	2.14	0.77	62II- 83I
Canada	3.57 (7.0)	-0.47 (4.8)		1.07 (9.6)	1.02	1.70	0.73	61I - 83I
Australia	4.78 (2.7)	-0.48 (1.9)		0.66 (1.5)	2.46	1.88	0.44	69II- 83I
Austria	2.52 (2.1)		-2.27 (3.5)	0.97 (2.9)	1.13	1.95	0.67	70II- 83I
Netherlands	4.92 (4.3)		-2.24 (5.6)	0.94 (3.5)	1.17	2.03	0.63	69I- 82II

a. All equations are estimated by two-stage least squares on seasonally-adjusted semi-annual data, all per cent changes refer to semi-annual changes. Except for the Netherlands, all equations include dummy variables and the equations for the United States and France include the rate of change of the minimum wage. The specification of the dummy variables and the estimated coefficients are reported in Table 8. The absolute values of t-statistics appear in parentheses below the coefficient estimates.

b. Specified as current inflation for Japan; a two-semester moving average for Germany, France, Italy, Austria, Australia and the Netherlands; a three-semester moving average for the United Kingdom and Canada; separate two- and eight-semester moving averages [respective coefficients of 0.26 (t-statistic of 3.2) and 0.75 (5.0)] for the United States.

c. The second equation includes a two-semester moving average of the rate of growth of productivity with an estimated coefficient of 0.68 (t-statistic of 3.3).

equations are estimated by two-stage least squares with a lagged value of the inflation term, the current and lagged growth of the money stock and all other independent variables used as instruments.

7. With regard to equation selection criteria, the most important a priori desideratum is that it include explicitly an activity variable and an inflation variable and be consistent, insofar as possible, with known institutional aspects of the relevant country. For most of the hypotheses tested, theory provides little, if any, a priori guidance beyond the expected direction of causality. In these cases, consistency with the data as revealed by the standard tests for significance becomes an important additional criteria. Where the data do not provide strong evidence to either support or reject a hypothesis, Occam's razor is appealed to and the simplest and most straightforward hypothesis is accepted. Given the number of alternative specifications and the fact that they are neither independent nor mutually exclusive, a nested hypothesis approach to testing, proceeding from the most general to the particular, is not feasible.

B. The specification of the activity variable

1. The linearity or non-linearity of the Phillips curve

8. Labour demand is employment plus vacancies and labour supply is employment plus unemployment. Thus proportional excess demand in the labour market is measured by the vacancy rate minus the unemployment rate. Vacancy data exist for only a few countries but it has been shown that the vacancy and unemployment rates are related in a hyperbolic fashion, i.e. the vacancy rate (V) can be expressed as a function of the inverse of the unemployment rate (e.g. V=a22/U) (2).

9. On this interpretation, the activity term in equation [1] (-a2.U) would be modified to include both the level and the inverse of the unemployment rate (-a21.U + a22/U). In terms of the shape of the Phillips curve, the inverse term would dominate at low rates of unemployment (w going to infinity as U goes to zero), whereas the level term would dominate at high rates of unemployment (the slope going to -a21 as U gets large). The estimation results, however, always failed to support such a combined specification.

10. Most empirical estimates of the Phillips curve prior to the 1980s specified only the inverse of the unemployment rate, suggesting decreasing returns to unemployment as an instrument of anti-inflation policy. This specification was consistently supported (or not rejected) by the data (3); but this result was based on estimation periods during which the unemployment rate was relatively stable so the difference between a level and an inverse specification was not great. Since 1980, however, unemployment rates have risen to post-war highs in many countries and inflation has fallen sharply. At a minimum, these developments appear to cast doubt on any a priori presumption of a non-linear Phillips curve.

11. At high rates of unemployment, the implications for wage developments are very different on the flat, far right part of a non-linear Phillips curve compared to a linear Phillips curve. This is shown in Table 2 where the change in wage inflation given by a 1 percentage point increase in the unemployment rate is computed, assuming "typical" coefficients, under each of three alternative linearity specifications: (i) a linear specification as in

Table 2

IMPLICATIONS OF ALTERNATIVE LINEARITY SPECIFICATIONS (a)

	Linear	Non-linear	
	$w = -0.5\,U + \ldots$ $dw = -0.5dU + \ldots$	$w = -2\log U + \ldots$ $dw = -(2/U)dU + \ldots$	$w = 7/U + \ldots$ $dw = -(7/U^2)dU + \ldots$
U	dw/dU	dw/dU	dw/dU
20	-0.5	-0.10	-0.02
15	-0.5	-0.13	-0.03
12	-0.5	-0.17	-0.05
10	-0.5	-0.20	-0.07
8	-0.5	-0.25	-0.11
6	-0.5	-0.33	-0.19
4	-0.5	-0.50	-0.40
2	-0.5	-1.00	-1.75
1	-0.5	-2.00	-7.00

Memorandum: approximate ranges of the unemployment rate

	1970 to 1982	1983 to 1985 (b)
United States	5 to 10	7 to 10
Japan	1 to 3	2 to 3
Germany	1 to 6	7 to 8
France	2 to 8	8 to 11
United Kingdom	3 to 12	11 to 12
Italy	5 to 9	9 to 10
Canada	5 to 11	11 to 12
Australia	2 to 7	8 to 10
Austria	2 to 4	4 to 5
Netherlands	1 to 12	14 to 16

a. The assumed coefficients correspond roughly to the average of the relevant coefficient estimates given in Table 3, excluding Japan, the United Kingdom and Australia.

b. Forecasts are from OECD, Economic Outlook 35.

equation [1], implying that a given change in U has the same impact regardless of the level of U; (ii) a non-linear specification of the inverse of U; and (iii) a non-linear specification intermediate between (i) and (ii) of the log of the unemployment rate implying that a given percentage increase (not percentage point increase) has the same impact regardless of the level of U. At unemployment rates around 10 per cent, not uncommon by recent standards, the reciprocal specification shows almost no reduction in wage inflation resulting from a 1 percentage point increase in the unemployment rate. Thus this specification, and to a lesser extent the logarithmic specification, has strong implications for wage inflation when unemployment rates move beyond the range experienced in the estimation period.

12. Table 3 presents equations comparable to those in Table 1 but estimated with the alternative specifications of the unemployment rate. Also reported in Table 3 are the equation errors from 1980I, a period when the unemployment rate increased to levels outside the pre-1980 range. For the United States, France, Canada and especially the United Kingdom, the linear specification dominates based on the standard criteria as well as equation performance since 1980. For Italy there is little to choose between the alternatives. The logarithm of the unemployment rate works better for Japan and Germany. For Austria and the Netherlands a non-linear specification is also preferable; given the implications of the reciprocal specification shown in Table 2, the logarithmic specification has been chosen, although not clearly superior on statistical grounds. For Australia, the alternative specifications perform equally badly. These results are the basis for the specification of the unemployment rate term reported in Table 1. Nevertheless, the tests of other hypotheses reported below are done for both linear and non-linear specifications.

2. Dynamic specification of the unemployment rate

13. The early literature often reported counter-clockwise loops around estimated Phillips curves (4). This can be allowed for by including the change in the unemployment rate as an additional argument in the basic equation. The expected coefficient would be negative implying that a given change in the unemployment rate would result in an overshoot of wages and hence counter-clockwise loops. This might represent a type of "speed limit" on changes in the unemployment rate. A specification with the change in the unemployment rate as the only activity variable is difficult to justify since there is no longer any link between wage inflation and the level of excess demand in the labour market. When changes in the unemployment rate were entered as an additional argument in the basic equation (both linear and non-linear versions), however, they were never significantly different from zero in any country, and were often incorrectly signed (5).

14. Given the existence in some countries of long-term contracts, either explicit or implicit, past values of the activity variable should, in principle, have an impact on current wage developments. The unemployment rate, however, is generally considered to be a lagging indicator of labour market conditions due to the hiring and firing practises of firms as reflected in the pro-cyclical movement of productivity. Thus the most common specification involves only contemporaneous values of the unemployment rate. When short (less than two years) lag distributions of the unemployment rate were included in the basic equation, the results were inferior to a specification of just the contemporaneous level of the unemployment rate.

Table 3

LINEAR VERSUS NON-LINEAR PHILLIPS CURVES (a)

	Specification (b)	Estimated coefficient	t-statistic	DW	$\bar{R}^2$	Equation error (actual minus predicted)								
						80I	80II	81I	81II	82I	82II	83I	Average	RMSE
United States	U	-0.33	5.1	1.74	0.90	-0.06	0.32	0.04	-0.26	-0.15	-0.05	-0.37	-0.08	0.22
	Log U	-1.95	4.7	1.48	0.89	-0.04	0.32	0.04	-0.25	-0.25	-0.29	-0.48	-0.14	0.28
	1/U	8.28	3.9	1.22	0.86	-0.02	0.30	0.07	-0.19	-0.31	-0.49	-0.61	-0.18	0.35
Japan	U	-3.88	7.9	1.84	0.90	-2.05	-0.93	-0.70	-0.04	-0.03	1.72	1.37	-0.09	1.22
	Log U	-6.24	8.2	1.94	0.90	-1.92	-0.92	-0.77	-0.04	-0.15	1.48	1.26	-0.15	1.13
	1/U	9.57	7.8	1.97	0.89	-1.83	-0.95	-0.86	-0.07	-0.26	1.28	1.16	-0.22	1.07
Germany (c)	U	-0.28	3.3	2.44	0.68	0.06	0.41	-0.84	0.09	-1.07	0.24	0.76	-0.05	0.62
	Log U	-0.68	3.5	2.43	0.69	0.23	0.50	-0.83	0.01	-1.30	-0.17	0.24	-0.19	0.63
	1/U	0.92	3.2	1.93	0.68	0.28	0.54	-0.86	-0.18	-1.56	-0.54	-0.17	-0.35	0.75
	Log(U/U*)	-1.14	3.2	2.31	0.66	-0.52	0.07	-1.17	-0.52	-1.75	-0.59	-0.33	-0.69	0.88
France	U	-0.31	3.8	1.93	0.85	-0.10	-0.10	-0.02	0.00	0.17	-1.58	1.12	-0.08	0.74
	Log U	-1.12	2.8	1.71	0.82	-0.10	-0.13	-0.16	-0.32	-0.17	-1.94	0.71	-0.30	0.80
	1/U	1.43	1.0	1.42	0.78	0.00	-0.01	-0.27	-0.62	-0.42	-2.53	0.06	-0.54	0.99
United Kingdom	U	-0.17	1.9	1.72	0.77	-0.01	-1.59	-3.53	0.54	-0.37	-1.19	1.65	-0.64	1.67
	Log U	-0.46	1.0	1.61	0.75	0.06	-1.68	-3.83	-0.07	-0.91	-1.83	0.95	-1.02	1.80
	1/U	-0.22	0.2	1.52	0.74	0.09	-1.78	-4.18	-0.41	-1.46	-2.50	0.21	-1.43	2.04
	U-U*	-0.42	2.4	1.82	0.79	-0.45	-1.59	-3.23	0.95	-0.09	-0.98	1.59	-0.54	1.58
Italy	U	-0.55	2.7	2.14	0.77	2.34	-3.74	0.77	4.10	1.42	-2.55	-0.17	0.31	2.55
	Log U	-2.79	3.1	2.20	0.77	2.38	-3.66	0.71	3.92	1.10	-2.79	-0.68	0.14	2.52
	1/U	11.48	3.1	2.19	0.77	2.41	-3.62	0.64	3.74	0.80	-3.04	-1.10	0.03	2.52
Canada	U	-0.47	4.8	1.70	0.73	-0.84	-0.92	0.02	0.76	0.89	-1.40	-0.38	-0.26	0.85
	Log U	-2.57	3.3	1.51	0.70	-0.73	-0.76	0.19	0.86	0.68	-2.25	-1.27	-0.47	1.10
	1/U	10.70	2.7	1.38	0.66	-0.69	-0.64	0.35	0.93	0.47	-2.89	-1.99	-0.63	1.36
Australia	U	-0.48	1.9	1.88	0.44	-0.37	1.53	1.80	0.53	4.49	2.98	-2.48	1.21	2.43
	Log U	-1.81	1.7	1.90	0.43	-0.34	1.59	1.95	0.62	4.47	2.61	-3.39	1.07	2.54
	1/U	5.29	1.4	1.90	0.41	-0.41	1.53	1.94	0.57	4.35	2.28	-4.00	0.89	2.59
	U-U*	-1.78	3.6	2.16	0.59	-2.02	-0.49	-0.94	-1.81	2.68	2.82	-0.16	0.01	1.84
Austria	U	-0.95	3.0	1.74	0.62	-1.01	-0.83	0.27	-1.74	-0.62	0.22	1.51	-0.31	1.03
	Log U	-2.27	3.5	1.95	0.67	-0.89	-0.66	0.47	-1.57	-0.51	0.14	1.29	-0.25	0.91
	1/U	4.38	3.8	2.05	0.68	-0.73	-0.50	0.59	-1.53	-0.57	-0.13	0.91	-0.28	0.81
Netherlands	U	-0.41	4.6	1.66	0.55	-1.20	-2.31	-2.60	2.22	0.87	1.40		-0.27	1.86
	Log U	-2.24	5.6	2.03	0.63	-0.84	-2.04	-2.43	2.12	0.45	0.81		-0.32	1.64
	1/U	8.17	5.5	2.04	0.61	-0.66	-2.07	-2.62	1.68	-0.19	0.11		-0.63	1.55

a. Except for the Netherlands, all equations include dummy variables as reported in Table 8. The specification of the unreported inflation term is given in Table 1, note b.

b. As discussed below, U* is a proxy for the natural rate of unemployment and is defined as a four-year moving average of the unemployment rate (see Table 4).

c. Includes a two-semester moving average of the growth of productivity.

Testing for a more long-lived impact of unemployment on wages is discussed below in the context of testing the hypothesis of hysteresis in the natural rate. It should be noted that Phillips curves estimated with a lagged dependent variable impose the identical lag distribution on the unemployment rate as on the inflation term. This may represent an important mis-specification for countries such as the United States where institutional features suggest long lags on the inflation term.

3. Hysteresis in the natural rate

15. As noted in the introduction, the labour market is in equilibrium at the natural rate of unemployment. If independent estimates of the true natural rate (denoted U*) are available, they can be explicitly incorporated into the Phillips curve by estimating,

$$w_t = a0 + a1.pe_t - a21(U-U^*)_t + a3.X_t, \qquad [2]$$

or the comparable non-linear version. If U* is constant over the estimation period, estimating the above equation will be econometrically equivalent to estimating equation [1] where just the level of U appears (only the estimated constant will be different).

16. But estimates of the natural rate, which will not in general be constant, are rarely available. Most estimates of the non-accelerating inflation rate of unemployment (the NAIRU) reported in the literature, and those reported in Table 11 below, tend to follow developments in actual unemployment rates. As noted below, this may be a consequence of the calculation methods. Another possibility is a causal relationship running from actual and past unemployment rates to the natural rate. One hypothesis, which is certainly not new, is that unemployment destroys human capital, undermines the work ethic, and, if accompanied by low investment, reduces fixed capital formation (6). Ultimately, if labour markets "work" this need not affect the natural rate but it would certainly reduce the equilibrium real wage relative to trend. Inertia in wage behaviour (or a shift in labour supply) could then change the natural rate.

17. The implications of this hypothesis of hysteresis in the natural rate are quite different from those associated with the conventional natural rate hypothesis: if the other structural factors affecting the natural rate are unchanged, then the disinflationary (inflationary) impact of a given gap between the actual and the natural rate of unemployment will disappear over time as the natural rate catches up with the actual rate. This possibility would appear to be consistent with the European experience since the late 1970s and projections to the late 1980s: the sharp rise in unemployment between 1980 and 1984 to rates far higher than most estimates of the natural rate was accompanied by an impressive deceleration of inflation; yet although unemployment rates are generally projected to level off or increase somewhat more over the period 1985 to 1988, inflation is expected to remain relatively stable implying little difference between the actual and the natural rates. There are few changes in structural factors in the most recent period that would explain such a dramatic rise in the natural rate.

18. The simplest test of the hysteresis hypothesis is to define U* as a distributed lag on past values of U in the estimation of equation [2]. This also tests for a long-lived impact of unemployment rates on wage inflation if

the constraint in equation [2] that U and U* have the same but opposite-signed coefficient is dropped. The estimated equation in linear form is:

$$w_t = a0 + a1.pe_t - a22.U_t \mp a23.U^*_t + a3.X_t. \qquad [3]$$

A significant positive estimated coefficient on U* of roughly the same size as a22 would be evidence of hysteresis in the natural rate (7); whereas a significant negative estimated coefficient on U* would be evidence of lagged responses to the unemployment rate. Estimates of equation [3], using either a four- or an eight-year moving average of the unemployment rate, indicate that there is some evidence of a long-lived impact of unemployment in the United States, Japan and Canada where the estimated coefficient on U* was negative but never statistically different from zero. For North America these very weak results would be consistent with the relatively long-term contracts compared to the other countries. For France, Italy, Austria and the Netherlands, both of the estimated coefficients a22 and a23 in equation [3] were either insignificantly different from zero and/or perversely signed. Estimates of equation [3] for Germany, the United Kingdom and Australia gave the following coefficient estimates (t-statistics in parentheses):

	a22	a23
Germany	-1.41 (3.6)	0.61 (1.4)
United Kingdom	-0.52 (2.0)	0.63 (1.4)
Australia	-1.76 (3.6)	1.61 (2.8)

19. Table 4 reports estimates of equation [2] (where the restriction a23 = -a22, the hysteresis hypothesis, is imposed) for a number of countries. In the case of Australia the improvement relative to the equation with just the unemployment rate is dramatic. As well as improving the explanatory power of the equation, the coefficient estimates on both the activity variable and the inflation term become significantly different from zero, and the coefficient on the inflation term corresponds more closely to <u>a priori</u> beliefs. For the United Kingdom there is a marginal improvement in the equation. For the other countries, incorporating a natural rate specified in this way makes little difference to the estimation results and hence the more straightforward specification of equation [1] is maintained. Thus the hypothesis of hysteresis in the natural rate appears to be strongly supported by the data only for Australia; for a few other countries, the hypothesis does not appear to be inconsistent with the data.

4. Alternative activity variables

20. Thus far it has been accepted that the unemployment rate is an appropriate measure of labour market conditions. Vacancy data, as noted, are not available for many countries. Unemployment rates for specific sectors of the labour market such as prime-age males are also often used in wage equations, although previous Secretariat work has not found important differences from using these more narrowly-defined unemployment rates.

21. An alternative, less direct, activity variable which has been used in some studies is the rate of growth of real output or industrial production.

Table 4

THE PHILLIPS CURVE WITH THE NATURAL RATE (U*) SPECIFIED AS A MOVING AVERAGE (a)

	Constant	Unemployment rate (U) (b)		Inflation term	SEE	DW	$\bar{R}^2$	Fit period
		U-U*	Log (U/U*)					
Japan	2.66 (3.9)		-7.45 (4.1)	1.22 (8.1)	1.66	1.25	0.76	68I - 83I
Germany (c)	0.44 (0.1)		-1.14 (3.2)	1.03 (4.5)	0.95	2.31	0.66	64I - 83I
United Kingdom	1.80 (3.4)	-0.42 (2.4)		1.00 (9.9)	1.42	1.82	0.79	65I - 83I
Canada	1.30 (3.6)		-2.18 (1.9)	0.84 (7.4)	1.25	1.28	0.63	61I - 83I
Australia	2.94 (1.9)	-1.78 (3.6)		0.90 (2.6)	2.09	2.16	0.59	69II- 83I
Austria (d)	1.65 (5.1)	-1.19 (2.3)		0.97 (3.6)	1.14	1.29	0.74	71I- 83I

a. See notes a and b to Table 1.

b. U* is defined as a four-year moving average of lagged unemployment rates, except for Japan which is an eight-year moving average.

c. Includes a two-semester moving average of the growth of productivity with an estimated coefficient of 0.68 (t-statistic 3.3).

d. With this specification of the natural rate, the linear specification gave better results than the logarithmic specification reported in Table 1. The fit period is one semester shorter due to data availability.

When contemporaneous or a two-period moving average of real GDP growth is substituted for the unemployment rate in equation [1] it is generally significant and correctly signed. But the explanatory power of the equation always falls and the serial correlation of the errors increases. The tests of bargaining models discussed below suggest that in some countries profits may also capture excess demand effects, although not as well as the unemployment rate. The importance of the unemployment rate in the public debate in all countries suggests that it is an appropriate measure, indeed perhaps the best measure, of labour market demand pressures for an economy-wide wage equation.

C. The specification of the inflation variable

22. Most of the Phillips curve literature asserts that it is expected inflation which is relevant in the wage equation. Furthermore, a unitary coefficient is often imposed on the expected inflation proxy on *a priori* grounds. It is argued in this section that the imposition of a unit coefficient may be inappropriate. Similarly, a less constrained *a priori* interpretation of the inflation variable is suggested, especially in view of country-specific institutional features.

1. Should real or nominal wages be the dependent variable?

23. Formal or informal indexation of wages to present or past inflation is a feature of virtually all developed economies (8). But the form that indexation takes varies widely among countries and also among industries within the same country depending upon, among other things, the degree of unionisation and the rate of inflation. Even when there is explicit indexation, however, it rarely provides for 100 per cent indexation of wages to prices. Formal contractual indexation is also incomplete in a number of other dimensions: it generally only applies to a portion of the labour force; it usually only applies to a part of the total wage bill, often excluding fringe benefits and overtime, for example; it is not continuous but lags actual price movements; and it is often based on price indices more narrowly defined than aggregate measures of inflation. Informal indexation, which can be expected to share many of the above characteristics and may result, for example, from implicit contracts embodying a commitment to the maintenance of real or relative wages, may also be important in countries where the labour force is not highly organised.

24. These institutional characteristics of the wage determination process suggest that a unitary coefficient on current inflation should not generally be imposed. On *a priori* grounds, the unit coefficient would apply to expected inflation or some distributed lag in past inflation rates, since it seems unlikely that the growth of real wages would change indefinitely in response to changes in inflation rates unless "real" variables, such as the terms of trade, were altering. But even here, the unit coefficient might best be considered an *a priori* guide to the expected size of the estimated coefficient rather than a precise value to be imposed in all cases. This is especially true for the relationship between an aggregate measure of earnings, such as national accounts wages per employee, and an aggregate measure of inflation, such as growth of the implicit price deflator for consumer expenditures. Thus the estimated coefficient a1 in equation [1] can be expected to be approximately equal to unity, the extent to which it differs from unity

depending on how well the inflation term (a distributed lag on inflation) reflects country-specific institutional features or the process of expectation formation.

25. As can be seen in Table 1, the freely estimated al coefficients range from about 0.9 to 1.0 and are not significantly different from one for most countries. In the equations for Germany without productivity growth and for Australia, the estimates are about 0.6 which appears to be too low to be consistent with institutional features of wage bargaining in those countries. As shown in the second German equation in Table 1, the inclusion of productivity growth raises the inflation coefficient to near unity. When the natural rate of unemployment is specified as a moving average as in Table 4, the inflation coefficient in the Australian equation increases to 0.9 and becomes significantly different from zero. This result, together with the emergence of a significant activity effect, suggests that the hypothesis of hysteresis in the natural rate may be an appropriate one for Australia.

2. Expected or past inflation

26. The existence of indexation and the fact that it is an *ex post* adjustment of wages to changes in prices, suggests that past inflation, rather than expected inflation, is the more relevant concept for determining wages in anything other than an accelerating hyperinflation. Microeconomic studies of wage formation often stress the importance of relative wages which also indicates a backward-looking adjustment of wages to prices. Commonly, expectations are assumed to be adaptive, i.e. specified as a distributed lag on present and past unemployment rates, and hence the empirical results are unable to distinguish among the alternative hypotheses of whether it is past inflation or backward-looking expectations of inflation which are relevant.

27. Given a backward-looking specification, the length of the lag on past inflation should be related to institutional features such as the speed of indexation and the length of contracts. In particular, one would expect longer lags on past inflation in North America, where staggered three-year contracts are the norm, than in Europe or Japan which are characterised by a one-year bargaining cycle. The lags reported in Table 1, note b are generally consistent with these institutional differences. Except for the United States, the price impacts are evenly distributed and complete in one to one-and-a-half years. For the United States the lags extend for four years with roughly half of the total impact complete in the first year and the remainder spread over the following three years. More complicated distributed lag specifications such as geometric or polynomial distributed lags did not improve the results. It should be noted that the size of the estimated coefficient on past inflation is not independent of the length of the lags. Table 5 summarises how the estimated coefficients vary for different lag lengths. The preferred lag specifications as given in Table 1 are thus based on both institutional considerations as well as the *a priori* presumption referred to above that this coefficient should be near unity.

28. The institutional grounds for specifying forward-looking price expectations do not appear to be strong. The theoretical grounds are based, at least in part, on a desire to avoid any specification that would imply the existence of persistent money illusion on the part of economic agents. Nevertheless, it is interesting to incorporate forward-looking price expectations into the wage equations. This has been done in three ways, all

Table 5

THE EFFECT OF ALTERNATIVE LAG LENGTHS ON THE ESTIMATED INFLATION COEFFICIENTS (a)

	Current inflation	Moving average of current and past inflation		
		2 semester	3 semester	4 semester
United States	0.56 (9.0)	0.58 (9.4)	0.62 (9.4)	0.70 (9.4)
Japan	0.89 (8.3)	0.78 (7.3)	0.67 (5.1)	0.62 (3.9)
Germany	1.07 (3.8)	0.88 (3.9)	0.82 (3.4)	0.86 (3.3)
France	1.19 (6.9)	0.94 (6.9)	0.91 (5.6)	0.93 (5.3)
United Kingdom	0.92 (8.1)	0.95 (9.2)	0.99 (9.3)	1.12 (9.4)
Italy	0.99 (7.1)	0.89 (7.4)	0.81 (6.5)	0.80 (5.7)
Canada	1.02 (9.6)	1.05 (10.1)	1.07 (9.6)	1.11 (10.1)
Australia	0.99 (3.1)	0.90 (2.6)	0.77 (2.2)	0.68 (1.9)
Austria	0.71 (2.1)	0.97 (2.9)	1.05 (3.3)	1.09 (3.3)
Netherlands (b)	0.92 (3.2)	0.94 (3.5)	1.11 (4.1)	1.05 (3.7)

a. These are the estimated coefficients (and t-statistics) for alternative specifications of the inflation term in the preferred equations reported in Table 1. For Germany the equation includes a two-semester moving average of productivity growth; for Australia, the preferred equation is reported in Table 4.

b. For the equations with three and four-semester moving averages, the estimation period is 1970I to 1982II.

in the context of single equation estimation methods and all focussing on the one-period-ahead expectation. The first and most straightforward assumption is rational expectations with perfect foresight, i.e. it was assumed that $pe_t = p_{t+1}$ in equation [1]. Rational expectations based on a more limited information set were also assumed by defining pe_t to be the one-period-ahead forecast from an estimated price equation. The second method is based on the predictions from a price equation specified as a reduced-form equation incorporating the most important exogenous (to the wage-price block) influences on prices such as the money supply. The third method is based on the predictions from a price equation estimated by time-series methods.

29. Table 6 reports the estimated Phillips curve equations for six countries with the lagged inflation term replaced by the three forward-looking measures of inflation. The estimated reduced-form and time-series inflation equations, from which inflation expectations (forecasts) have been derived, are reported in the appendix, Tables 13 and 14. Since the equations in Table 6 use an independent measure of inflation expectations, they are estimated by ordinary least squares; the estimation periods also differ somewhat from the equations reported in Table 1. Given these differences, comparisons are somewhat hazardous. For the United States, France (except in panel B) and the United Kingdom, the estimated unemployment rate coefficient becomes perversely signed and/or insignificantly different from zero when estimated with the alternative specification of inflation expectations. Otherwise, as a broad generalisation, most of the features of the estimates in Table 1 are maintained.

30. Equations were also estimated with a combination of forward-looking and adaptive inflation expectations. For the United States this was done by replacing the two-semester moving average of inflation in the original specification (see note b to Table 1) with the alternative inflation expectation terms used in Table 6 while maintaining the second inflation term of an eight-semester moving average. For the other countries the alternative inflation expectations terms used in Table 6 were included, together with the inflation terms reported in Table 1. These equations are reported in panel A of Table 6 for the United States and Japan. The results for the other countries were not interesting. For the United States very similar results were obtained for each of the other expected inflation specifications in Table 6; for Japan similar results were obtained with the perfect foresight specification. For the United States, this hybrid model is much closer to the original specification and the results are much improved, particularly with regard to the estimated unemployment coefficient, compared to the pure expectation equation. For both the United States and Japan, the sum of the coefficients on the two inflation terms is near unity.

31. It is difficult to arrive at strong conclusions from these results. This is not surprising since they are based on a test incorporating both specific hypotheses of expectations formation as well as hypotheses about wage determination. Limited as these tests for forward-looking inflation expectations are, they do not suggest a significant improvement over a specification using current and past inflation. The data appear to support institutional evidence suggesting that wage determination, at least when inflation is not accelerating, allows for an ex post adjustment to inflation. Unless inflation expectations are pathological, it may be possible to overstate their importance.

Table 6

ALTERNATIVE SPECIFICATIONS OF INFLATION EXPECTATIONS (pe) (a)

	Constant	Unemployment rate		Expected inflation	Past (b) inflation	SEE	DW	$\bar{R}^2$	Fit period
		U	Log U						
A. pe as the forecast from a reduced-form inflation equation									
United States	1.22 (4.8)	0.11 (3.0)		0.48 (7.7)		0.38	0.82	0.76	65I - 82II
	2.42 (10.4)	-0.31 (4.8)		0.18 (3.1)	0.84 (7.0)	0.23	1.70	0.90	65I - 82II
Japan	4.96 (3.2)		-5.22 (3.0)	0.99 (5.7)		1.25	1.29	0.88	71I - 81I
	5.0 (5.4)		-6.1 (5.9)	0.56 (4.5)	0.52 (5.8)	0.73	2.14	0.96	71I - 81I
Germany (c)	0.93 (0.7)		-0.48 (1.9)	0.89 (3.5)		1.02	2.41	0.63	64I - 81II
France	1.92 (4.7)	-0.09 (0.9)		0.85 (5.0)		0.83	1.40	0.77	65I - 82I
United Kingdom	1.35 (1.4)	0.15 (1.1)		0.84 (6.3)		1.85	1.55	0.65	66I - 82I
Canada	2.05 (3.6)	-0.22 (2.3)		1.01 (9.8)		1.05	1.69	0.74	61I - 82II
B. pe as the forecast from an auto-regressive inflation equation									
United States	1.37 (4.9)	0.17 (4.1)		0.42 (6.5)		0.42	0.71	0.70	65I - 82II
Japan	6.40 (6.7)		-8.02 (7.6)	1.05 (8.4)		0.95	1.63	0.93	71I - 81I
Germany (c)	0.55 (0.6)		-0.58 (2.4)	1.07 (3.9)		0.99	2.62	0.65	64I - 81II
France	1.88 (5.4)	-0.20 (2.1)		1.01 (6.5)		0.72	1.80	0.82	65I - 82I
United Kingdom	3.23 (3.6)	0.18 (1.1)		0.47 (4.7)		2.15	1.63	0.52	66I - 82I
Canada	2.77 (4.7)	-0.33 (3.1)		1.00 (9.3)		1.09	1.7	0.71	61I - 82II
C. Perfect foresight, i.e. pe(t) = p(t+1)									
United States	1.32 (4.6)	0.12 (2.7)		0.43 (6.3)		0.42	1.28	0.68	65I - 82II
Japan	8.18 (4.9)		-8.14 (4.0)	0.59 (3.4)		1.64	1.48	0.80	71I - 81I
Germany (c)	1.05 (1.5)		-0.48 (2.1)	0.81 (4.3)		0.96	2.61	0.66	64I - 81II
France	2.32 (5.7)	-0.02 (0.2)		0.54 (4.1)		0.90	1.35	0.73	65I - 82I
United Kingdom	2.05 (2.3)	0.14 (1.0)		0.72 (5.9)		1.91	1.55	0.62	66I - 82I
Canada	2.05 (3.3)	-0.17 (1.6)		0.90 (8.5)		1.16	1.60	0.68	61I - 82II

a. See notes a and b to Table 1.

b. Past inflation is as specified in Table 1, note b; for the United States only the eight-semester inflation term is used.

c. The three German equations include a two-semester moving average of productivity growth with estimated coefficients of 0.59 (2.7), 0.63 (2.9) and 0.61 (3.0), respectively.

D. The specification of other variables

1. Labour productivity

32. The textbook neo-classical theory of income distribution equates wages to the marginal revenue product of labour. Institutional features of wage bargaining in some countries indicate that, at least during specific historical periods, productivity growth may have been an important determinant of wage increases. Given the hiring and firing practices of firms, it may be trend rather than actual productivity developments which are relevant. Trend productivity growth will by definition be relatively stable, and is usually considered to be incorporated into the constant term.

33. Various specifications of current and trend productivity have been included in the estimated equations but were always insignificant and/or wrongly signed except for Germany. The second German equation reported in Table 1 includes a two semester moving average of the growth of aggregate productivity (defined as real GDP per employed person). Including productivity not only increases the overall explanatory power of the German equation but also has the effect of increasing the coefficient on the inflation term from 0.6 to close to unity. This suggests that cyclical productivity movements have a significant impact on German wage developments, a result consistent with the institutional features of German wage bargaining.

2. Real wage bargaining and "catch-up"

34. As noted in the Introduction, bargaining models of wage determination may be thought to underlie the short-run Phillips curve (9). These models emphasize that the presence of trade unions and large corporations suggests a bargaining process closer to a bilateral monopoly than perfect competition; indeed, in some bargaining models the neo-classical assumption of a competitive labour market is assumed to be largely irrelevant in many sectors of the economy. Within this context the bargaining process is carried out over nominal wages although trade unions are mainly concerned with achieving a target real disposable earnings. Thus, increases in taxes can lead to tax-push inflation as wage earners demand higher nominal wages to offset the reduction in disposable income (10).

35. It is usually assumed that the actual change in nominal wages is mainly explained by the gap between the target real disposable wage and the previous real disposable wage. A crucial question is how the target real disposable wage is determined by the unions and the relative weight they put on demand factors in the labour market, as measured by the unemployment rate, past or expected inflation, the rate of growth of productivity and the average tax rate on household income, or alternatively one minus that rate, the retention ratio. The outcome of the bargaining process, of course, also depends upon the willingness or ability of firms to concede wage increases. This is assumed to depend upon the state of the labour market and the ability of firms to pay, i.e. profits. There could also be a backward-shifting of employers' contributions for pensions, social security, etc. (11). Assuming a linear relationship, the bargaining model can be specified as an expanded version of equation [1] which includes (in X, the vector of other relevant variables) the growth of productivity, the change in the retention ratio, some measure of profits and, importantly, the lagged real disposable wage. The presence of the last variable indicates that any failure to achieve a target real wage in

one period results in more aggressive nominal wage claims subsequently as an attempt is made to "catch-up" on past real wage shortfalls. Note that in the absence of this variable, lags in the response of wage growth to inflation imply that a permanent change in the level of real wages occurs whenever inflation changes.

36. Table 7 summarises the results of testing some of the additional variables suggested by bargaining models. The results with regard to profits are somewhat surprising (12). In Japan where institutional aspects strongly indicate an important role for profits they were never significant and incorrectly signed when entered together with the logarithm of the unemployment rate, and the logarithm of the lagged real disposable wage; when profits were entered without the lagged real disposable wage, the unemployment rate became perversely signed. For Canada, the profits variables were positive and significant only in equations with no activity variable, and then other aspects of the equation were less satisfactory. For the United States and Germany profits were significant, if marginally so, though affecting the coefficient on inflation somewhat. With regard to the logarithm of the lagged real wage, this was marginally significant for the Netherlands and Germany, where, however, it competes with the profits variable. The two tax rate variables were never significant except for the growth of the retention ratio in Australia, but other aspects of this equation were unsatisfactory.

37. These tests of hypotheses associated with the bargaining model have yielded largely negative results. This may be due in part to the aggregative nature of the wage and profits data. As its name implies, the bargaining model is most applicable to economies characterised by highly centralised wage bargaining. Empirical support for bargaining models is found mostly in studies of the United Kingdom, except for Austria, the most unionised of the countries studied here; and many of these studies were done in the mid-1970s (13). The inability to find significant tax effects on wages is disappointing but not surprising. Measures of aggregate average tax rates will be affected by many factors which are independent of changes in the relevant statutory tax rates. As a generalisation, the institutional grounds are not compelling for assuming a direct link between taxes and wages, and this is probably particularly true for small changes in taxes. When assessing the possible consequences of large changes in taxes, however, it would clearly be prudent to make alternative assumptions about possible wage impacts.

3. Incomes policies and other country-specific variables

38. A number of other country-specific influences may have had important impacts on wage formation. These include government policies such as minimum wages and explicit wage controls or guidelines, and any associated catch-up after their removal. There have also been unusual socio-political events, such as those which occurred in France and other European countries in the late 1960s, which resulted in, or were associated with, unusual wage developments. Dummy variables have been used to test for the impacts of these unusual policies or events. To the extent that these dummy variables capture the effects of significant exogenous events, to exclude the dummy variables would result in biased coefficient estimates. In general the inclusion of the dummy variables, which are concentrated around 1970 and 1974, tend to improve somewhat the tracking performance of the equation in the more recent period but have little impact on the size or significance of the other coefficient

Table 7

BARGAINING MODELS (a)

	Constant	Unemployment rate: U	Unemployment rate: log U	Inflation term (b)	Log of lagged real: disposable wage	Log of lagged real: profits (c)	Growth of: retention ratio	Growth of: employers' tax rate	Growth of: productivity	SEE	DW	$\bar{R}^2$	Fit period
United States (d)	2.64 (4.8)	-0.30 (1.9)		1.34	-7.44 (0.9)		-0.51 (0.9)			0.46	1.40	0.62	65I- 82II
	0.31 (0.25)	-0.31 (4.9)		1.17		0.56 (1.9)				0.22	2.12	0.91	65I - 83I
Japan	4.41 (1.1)		-5.10 (1.4)	0.82 (4.9)	-6.72 (1.0)		0.11 (0.4)			0.90	1.58	0.94	71I - 83I
	-33.67 (2.2)		12.47 (1.7)	1.28 (6.5)		8.49 (2.6)				1.01	2.26	0.91	68I- 82II
Germany (e)	10.0 (1.6)		-1.24 (3.3)	0.58 (2.0)	3.46 (1.8)		-0.19 (1.1)		0.67 (3.2)	0.90	2.47	0.70	64I - 82I
	9.10 (2.0)		-0.97 (2.3)	1.36 (3.8)	-2.55 (1.9)		0.11 (0.2)		0.51 (1.5)	1.11	1.98	0.59	64I - 82I
	-4.21 (2.2)		-1.02 (3.0)	1.17 (5.3)		1.15 (2.3)			0.75 (3.9)	0.89	2.66	0.71	64I - 83I
France	30.47 (0.5)	-0.81 (2.9)		0.77 (3.1)	-3.18 (0.5)		-0.36 (1.2)	-0.07 (1.0)	0.18 (1.3)	0.69	2.06	0.85	64II- 83I
	0.16 (0.0)	-0.13 (0.6)		0.92 (6.7)		0.66 (0.8)				0.69	1.95	0.84	64II- 83I
United Kingdom	-16.26 (0.43)	-0.34 (2.4)		1.12 (6.6)	2.22 (0.5)		0.27 (1.3)		0.42 (2.0)	1.34	2.13	0.81	65I- 82II
Italy	23.9 (0.6)	-0.45 (1.2)		0.95 (3.9)	-1.52 (0.5)		4.89 (1.2)	0.46 (0.9)		1.52	1.48	0.84	62I- 81II
Canada	-71.00 (0.9)	-0.58 (3.8)		0.79 (2.3)	8.90 (1.0)		1.04 (1.2)			1.36	1.97	0.54	61I - 83I
	3.22 (5.5)	-0.40 (3.5)		1.05 (9.6)		2.10 (1.2)				1.01	1.80	0.74	61I - 83I
Australia (f)	3.23 (0.6)	-0.89 (1.4)		0.43 (0.7)	1.12 (0.1)		-1.28 (2.3)		0.03 (0.0)	2.04	2.07	0.61	69II- 83I
Netherlands	38.08 (2.01)		-1.92 (3.6)	0.95 (3.6)	-12.30 (1.8)		-0.05 (0.3)		0.18 (0.8)	1.13	2.20	0.66	69I- 82II

a. See note a to Table 1.
b. The lag distributions are given in note b to Table 1.
c. Profits are defined as the logarithm of the share of national accounts gross operating surplus in GDP. The alternative measure of the real return on capital gave similar results. For Canada the profits variable is entered as a growth rate.
d. The estimated price coefficients (t-statistics) on the two and eight-semester moving averages are: 0.19 (1.2) and 1.15 (2.1) in the first equation; and 0.26 (3.4) and 0.91 (5.7) in the second equation.
e. In the second and third equations, the unemployment rate is entered relative to a four-year moving average as in Table 4, i.e. as log(U/U*).
f. The unemployment rate is entered relative to a four-year moving average as in Table 4, i.e. as U-U*.

Table 8

COUNTRY-SPECIFIC VARIABLES

	Description	Non-zero values for dummy variables	Estimated coefficient	t-statistic
United States	Percentage change in the minimum wage.		0.01	(1.6)
	Dummy variable for unusually large wage increases.	1.0 from 70II to 72I	0.68	(5.2)
	Dummy variable for wage controls and subsequent removal.	1.0 from 73II to 74I, and -1.0 from 74II to 75I	-0.47	(3.5)
Japan	Dummy variable for unusual seasonal pattern.	1.0 in 74I and 75I, and -1.0 in 74II and 75II	-4.15	(7.6)
Germany	Dummy variable for the events of 1969.	1.0 from 69II to 70I	2.34	(4.6)
France	Percentage change in the minimum wage.		0.11	(3.0)
	Dummy variable for the events of 1968.	1.0 in 68II and -1.0 in 69I	1.77	(2.6)
United Kingdom	Dummy variable for unusually large wage increases, perhaps in anticipation of the imposition of wage controls.	1.0 in 70I	4.14	(2.8)
	Dummy variable for unusually large wage increases, perhaps associated with the newly-elected Labour government and the contract policy.	1.0 from 74II to 75I, and -1.0 from 75II to 77II	4.16	(7.2)
Italy	Dummy variable for the events of 1969-70.	1.0 in 70I	7.77	(4.3)
	Dummy variable for unusually large wage increases.	1.0 from 73I to 73II	6.30	(4.9)
	Dummy variable for the new agreement on the indexing system.	1.0 from 76II to 77I	4.44	(3.3)
Canada	Dummy variable for unusually small wage increases.	1.0 for 70I to 70II	-1.90	(2.6)
	Dummy variable representing possible effects of the Anti-Inflation Board policies.	1.0 from 76I to 77I, and -1.0 from 77II to 78II	1.20	(2.9)
Australia	Dummy variable for unusually large wage increases, possibly associated with an award in the National Wage Case by the Arbitration Commission.	1.0 from 74I to 74II	5.43	(2.8)
Austria	Dummy variable for unusually large wage increase, perhaps reflecting buoyant profits and unusually strong demand.	1.0 in 71I	5.45	(4.5)

Note: Except for Australia, these estimated coefficients are from the equations reported in Table 1. For Germany the relevant equation includes productivity growth. For Australia the relevant equation is reported in Table 4.

estimates. Table 8 contains a description of these variables together with the estimated coefficients and t-statistics.

III. STABILITY TESTS

39. The above results suggest that the augmented Phillips curve is a satisfactory framework for describing the short-run wage determination process in the countries examined. Given the wide range of variation in wage growth, inflation and unemployment rates over the estimation period, it is important to examine the stability of the estimated equations. The technique of recursive regressions tests for gradual changes in individual parameters by running a regression over an interval which is extended one period at a time, with the recursion done both backwards and forwards (14). Based on the recursive regression residuals, the Cusum and $Cusum^2$ statistics test the null hypothesis that the estimated coefficients from the different sub-samples are constant. The recursive regressions are not strictly comparable to those reported above since they are based on ordinary least squares, rather than two-stage least squares, and exclude all dummy variables. The results of the recursive regressions are reported in Table 9. Based on the Cusum test, the null hypothesis of equation stability is only rejected in the case of the forward recursion for Germany; based on the $Cusum^2$ test, stability is rejected for Japan, Germany, the United Kingdom, Italy, Australia and Austria. The results with alternative linear/non-linear specifications gave similar results.

40. Developments in the Quandt log likelihood ratio, which can be computed from the recursive regressions, suggest points where more sudden structural shifts may have occurred. Shifts in the estimated constant terms, as well as in some of the estimated slope coefficients, were tested using dummy variables. Only short-lived shifts in the constant term proved to be significant and these are reported in Table 8. The stability of the equations including all the dummy variables reported in Table 8 and based on two-stage least squares estimation has been examined using Chow tests. The sample was split into sub-intervals prior to (until 1973II) and after the first oil shock. And to test for the possibility of recent changes, the equations were estimated on the sub-interval to 1979 and then used to "forecast" the period from 1980I to 1983I.

41. The Chow test statistics are also reported in Table 9. For all countries except Austria the null hypothesis of equation stability over the period prior to 1973 compared to the period from 1974 onward cannot be rejected. There is evidence of more recent structural change only for the United Kingdom. Thus, for Japan, Germany, Italy, Australia, Austria and the Netherlands the inclusion of dummy variables may have captured the instability indicated by the test statistics from the recursive regressions. The recent stability of the equations is also apparent in Table 10 where the <u>ex post</u> forecast errors from the equations estimated to end 1979 (labelled "forecast") are compared to the residuals from the equations estimated over the full sample period (labelled "regression"). A comparison of the root mean square errors (RMSE) from the two equations confirms the results of the Chow test. Except for the United Kingdom, the two sets of residuals are quite similar.

Table 9

STABILITY TESTS

	Test statistic					
	Chow (a)		Recursive regressions (b)			
	divided at		Cusum		$Cusum^2$	
	end 1973	end 1979	f	b	f	b
United States	-0.79	1.34	0.91	0.85	0.15	0.11
Japan	1.06	1.55	0.45	0.64	0.32**	0.36*
Germany (c)	1.44	0.32	1.09*	0.66	0.33**	0.31**
France	-0.20	-1.21	0.83	0.54	0.17	0.24
United Kingdom	0.39	3.19*	0.37	0.49	0.25*	0.25*
Italy	0.41	-0.06	0.42	0.21	0.27*	0.26*
Canada	1.76	0.42	0.71	0.42	0.21	0.18
Australia	0.15	0.73	0.63	0.58	0.18	0.31*
Austria	7.09**	0.69	0.83	0.41	0.53**	0.54**
Netherlands	0.52	1.85	0.69	0.77	0.25	0.15

a. Based on the two-stage least squares regressions reported in Table 1 (Table 4 for Australia) and including the dummy variables reported in Table 8.

b. Based on ordinary least squares regressions specified comparable to those in Table 1 (Table 4 for Australia) and excluding all dummy variables. "f" ("b") denotes the test statistic from the forward (backward) recursion.

c. The equation includes productivity growth.

* Stability rejected at 5 per cent but not 1 per cent.

** Stability rejected at 1 per cent.

Table 10

COMPARISON OF REGRESSION AND FORECAST RESIDUALS (a)

"Regression" residuals are from equations estimated to 83I (or 82II)
"Forecast" residuals are from the forecasted values of equations estimated to 79II

		80I	80II	81I	81II	82I	82II	83I	RMSE
United States	Regression	-0.06	0.32	0.04	-0.26	-0.15	-0.05	-0.37	0.22
	Forecast	-0.04	0.31	-0.03	-0.39	-0.39	-0.36	-0.68	0.38
Japan	Regression	-1.92	-0.92	-0.77	-0.04	-0.15	1.48	1.26	1.13
	Forecast	-1.95	-0.94	-0.76	-0.02	-0.10	1.53	1.31	1.16
Germany (b)	Regression	0.23	0.50	-0.83	0.01	-1.30	-0.17	0.24	0.63
	Forecast	-0.16	1.29	0.27	-1.28	-0.77	-0.41	-0.89	0.84
France	Regression	-0.10	-0.10	-0.02	0.00	0.17	-1.58	1.12	0.74
	Forecast	-0.26	-0.27	-0.14	-0.08	0.05	-1.62	1.10	0.76
United Kingdom	Regression	-0.01	-1.59	-3.53	0.54	-0.37	-1.19	1.65	1.67
	Forecast	-1.54	-4.43	-7.80	-4.72	-6.04	-7.53	-5.01	5.65
Italy	Regression	2.34	-3.74	0.77	4.10	1.42	-2.55	-0.17	2.55
	Forecast	2.79	-3.29	1.28	4.66	2.01	-1.98	0.53	2.68
Canada	Regression	-0.84	-0.92	0.02	0.76	0.89	-1.40	-0.38	0.85
	Forecast	-1.09	-1.12	-0.17	0.49	0.37	-2.31	-1.31	1.19
Australia	Regression	-2.02	-0.49	-0.94	-1.81	2.68	2.82	-0.16	1.84
	Forecast	-2.52	-1.12	-1.89	-2.54	2.21	3.20	1.70	2.26
Austria	Regression	-0.89	-0.66	0.47	-1.57	-0.51	0.14	1.29	0.91
	Forecast	-0.99	-0.79	0.27	-1.78	-0.70	0.01	1.30	1.00
Netherlands	Regression	-0.84	-2.04	-2.43	2.12	0.45	0.81		1.64
	Forecast	-0.93	-2.14	-2.53	2.02	0.35	0.70		1.66

a. Actual minus predicted. The equation specification is the same as those reported in Table 1 (Table 4 for Australia) as supplemented by the additional variables in Table 8.

b. The equation includes productivity growth.

42. The results concerning recent structural change must be treated cautiously. The equation residuals in Table 10 are occasionally very large, even for some countries where the Chow test of equation stability cannot be rejected. Since 1980, unemployment rates in many countries have increased beyond the range in the pre-1980 sample period and it is unsurprising that these residuals are sometimes larger than those in the period up to 1980. Whether the equation errors from 1980 to 1983 represent permanent structural changes or just poor equation performance associated with an unusually deep and protracted recession is a question that will only be settled as more data become available.

IV. IMPLICATIONS AND CROSS-COUNTRY COMPARISONS OF THE ESTIMATED NOMINAL WAGE EQUATIONS

A. Implications for inflation

43. Nominal wage developments are the dominant proximate factor determining inflation pressures in the short run. Actual inflation developments will depend to a large extent on the degree to which policy does or does not accommodate these inflation pressures. The analysis presented above indicates that the augmented Phillips curve explains actual wage inflation over the period from about the mid-1960s to the early 1980s reasonably well. This section discusses the extent to which the estimated wage equations explain recent developments and considers the implications for short- and long-run inflation developments.

1. Short-term inflation developments

44. The decline in wage inflation during the 1980 to 1982 recession and the continued moderation of inflation during the recovery in 1983 and 1984 has often been described as surprising or unusual. As shown in the equation residuals reported in Tables 2 and 10, the estimated wage equations have in general overpredicted actual wage developments somewhat. This overprediction raises the question of whether structural change in wage behaviour has occurred. The formal tests of equation stability indicate that the prediction errors are not large enough relative to the standard errors of the estimated equations to substantiate that there has been a structural break. As yet, therefore, the evidence does not suggest a permanent change in the wage formation process which would lead to unusual wage moderation with the recovery.

45. The impact on wages of the unemployment rate is important for understanding recent as well as prospective wage developments. The analysis indicates that wage inflation is related to the level of, rather than the change in, the unemployment rate. Indeed, the change in unemployment appears to have no significant independent influence on wage growth, which suggests there are not important speed limits to the rapidity with which growth occurs in the upswing. In terms of the short-run dynamics of the wage equation, a maintained reduction (increase) in the unemployment rate will result in a sustained increase (decrease), without overshooting, in the rate of wage inflation. As discussed below, however, the estimated equation for Australia

which incorporates the hypothesis of hysteresis in the natural rate is unusual in this respect.

46. The perception that recent wage growth has been unusually moderate may have been due, at least in part, to the presumption of a non-linear Phillips curve. A linear rather than a non-linear specification of unemployment appears to be more consistent with recent wage developments in many countries. For those countries where the data suggest a non-linear relationship, a logarithmic specification worked better than the more non-linear specification of the reciprocal of the unemployment rate. Recent experience in most countries does not suggest that there are important decreasing returns from increases in the unemployment rate when it comes to reducing wage inflation, at least over the range of unemployment rates observed up to now. The implication for inflation prospects is that if unemployment is reduced with the recovery, the effect of this reduction, ceteris paribus, will be to increase wage growth, i.e. some of the wage inflation reduction due to the recession will be reversed. And conversely, if unemployment rates continue to rise, this will tend to further reduce wage growth.

47. Nominal wages also respond to past, and potentially to expected inflation developments. Except for the United States, the estimates reported above indicate that wage growth rapidly (within a year) reflects the full extent of any changes in consumer price inflation. Thus, during periods when factors such as productivity growth and commodity prices strongly influence consumer price inflation, this can be expected to affect wages rapidly via price/wage links and, if accommodated, set in train a wage-price spiral, either upward or downward. During the early 1970s there was clearly an upward spiral; recently, commodity prices have tended to lower inflation and this has been reflected in low wage growth. In the United States, however, nominal wages respond relatively slowly to inflation (about one-half of the total impact occurs within a year). This inertia means that wages have generally tended to follow, rather than lead, price developments. The long lags on the inflation term mean that the inertial component of U.S. wage behaviour is now established at a relatively low level, and will probably be reduced further.

48. One feature of the current recovery is the widespread fall in the labour share of national income and the associated rise in the profit share and profits. Another related development has been the decline or stagnation of real wages in many countries. In the context of a bargaining model of wage determination, it is sometimes argued that these developments could lead to subsequent pressures for an increase in wages in order to recoup or catch-up on previous real wage losses. In the analysis presented above, however, there was little empirical support at the macroeconomic level for the "catch-up" hypothesis. With the possible exceptions of Germany and Japan, there is also little statistical evidence that profits as conventionally measured at the macroeconomic level have important impacts on aggregate wage developments. As noted, these results are somewhat surprising since in Japan and, more recently, Germany there is strong institutional and anecdotal evidence of profit effects on wage demands. Such evidence may exist for other countries too, although, of course, a few well-publicised wage claims on the basis of profits or past declines in real wages do not necessarily have important effects on aggregate wage developments. On balance, although there do not appear to be empirical grounds in most countries for expecting a resurgence of

inflation based on "catch-up" wage increases, such pressures cannot be ruled out, particularly in countries where profits appear to be unusually high.

49. In summary, the decline of wage growth in the early 1980s and continued moderation through 1984 is relatively well explained by the high rates of unemployment and the additional downward pressure on inflation from commodity prices, direct demand effects on prices and, in some countries, exchange-rate movements. All of these phenomena, of course, are traceable to the widespread adoption of non-accommodating monetary policies after the second oil-price shock. International linkage effects undoubtedly intensified the disinflation process. Forward-looking expectations of lower inflation, perhaps traceable to policy pronouncements, may also have played a role, although these are difficult to verify empirically.

2. The long-run Phillips curve and the NAIRU

50. In the medium to long run wage developments can not be looked at in isolation, but inflation and inflation expectations must also be considered as endogenous. This makes it possible, in principle, to compute the level of the unemployment rate which is consistent with stable inflation and inflation expectations -- the NAIRU. A more satisfactory and ambitious approach, of course, would be to derive full model equilibrium estimates of the natural rate of unemployment.

51. The long-run properties of the estimated equation for Australia are unusual. The specification of hysteresis in the natural rate is essentially a change specification stretched-out over four years. This means that the wage inflation impact of reductions (increases) in the unemployment rate eventually disappears as the natural rate chases the actual rate down (up). Thus, for Australia, even without taking account of inflation and inflation expectations, there is no long-run relationship between wage growth and the level of the unemployment rate in the specification reported in Table 4.

52. The approach usually adopted for computing the NAIRU can be demonstrated using the augmented Phillips curve as given in equation [1] and the following cost mark-up price equation and an adaptive expectations equation, using established notation:

$$p_t = b0 + b1 \sum L1_i (w+s-q)_{t-i} + b2 \sum L2_i pm_{t-i} + b3.Z_t, \qquad [4]$$

$$pe_t = \sum L3_i p_{t-i}, \qquad [5]$$

where p is the rate of change of prices, s is the rate of change of one plus the effective tax rate on employers' contributions, q is trend productivity growth, pm is the rate of change of import prices and Z is a vector of other relevant variables. The $L1_i$ are distributed lag coefficients which sum to unity, and similarly for $L2_i$ and $L3_i$. If Z does not include any relevant cost variables, the constraint b2=1-b1 would be appropriate; and depending on the contents of Z, b0=0 may also be appropriate. Long-run equilibrium of the wage-price block will be characterised by stable inflation, wage growth, etc. and realised expectations, i.e.,

$$pe_t = p_t = p_{t-i}, \qquad [6]$$

and similarly for the other variables. The reduced-form wage equation from the wage-price block can be solved for by substituting equations [4], [5] and [6] into equation [1]. Dropping time subscripts, and normalizing on the unemployment rate consistent with this long-run wage-price equilibrium, the equation for the NAIRU ($\bar{U}$) is,

$$\bar{U} = (1/a2)[(a0+a1.b0) - (1-a1.b1)w + a1.b1(s-q) + a1.b2.pm + a1.b3.Z + a3.X]. \qquad [7]$$

53. Based on this approach, the structural determinants of the NAIRU are trend productivity growth, trend changes in the terms of trade, the tax rate for employers' contributions and other structural factors included in Z and X such as minimum wages, other tax rates, etc. The NAIRU given in equation [7] depends on wage inflation, so the long-run Phillips curve computed in this way is not vertical. Two assumptions are required for a vertical long-run Phillips curve : (i) that nominal wage growth eventually adjusts completely to price inflation, i.e. a1=1; and (ii) either that the economy is closed, i.e. b1=1 and b2=0, or that exchange rates adjust so that domestic costs and import prices change at the same rate over the relevant run, i.e. w=pm. With these assumptions, and assuming b2=1-b1, equation [7] reduces to,

$$\bar{U} = (a0 + b0 + b1(s-q) + b3.Z + a3.X)/a2, \qquad [8]$$

i.e. there is no relationship between wage inflation and unemployment and hence the long-run Phillips curve is vertical.

54. Using the parameters of the estimated wage equations and parameters for the price equations reported in the appendix, Table 15, it is possible to compute NAIRUs based on equation [7]. In principle, full model equilibrium values for trend productivity and terms-of-trade shifts should be used. These are not readily available and so average growth rates for w, pm, s and q have been used. This may bias the NAIRU estimates towards actual unemployment. When on average w-q-pm=0, this gives the same result as calculating the NAIRU via equation [8]. If terms of trade are shifting over the sample period, however, the NAIRU is affected. Two NAIRUs have been calculated differing only in the period over which average growth rates have been computed. As the period is shortened, the NAIRU becomes more sensitive to actual growth rates of import prices.

55. Table 11 reports estimates of the NAIRU computed in this way as well as estimates from the literature. It must be noted that the confidence intervals around these estimates are likely to be very large reflecting imprecise coefficient estimates and mis-specification in the wage and price equations. For this reason, as well as the analytic fuzziness of the NAIRU concept when applied to economies out of long-run equilibrium, the policy relevance of the estimated NAIRUs may not be great. At best, estimates of the NAIRU may provide rough guides as to when inflationary pressures stemming from the labour market might arise. For all countries, unemployment rates in the second half of 1984 are above, sometimes substantially so, the estimated NAIRUs, suggesting that the net demand effect on wage growth is currently negative and likely to stay so in most countries even if unemployment rates are lowered substantially during the recovery.

Table 11

NAIRU ESTIMATES

	Time period	Average unemployment rate	NAIRU estimates: This study (a) (1)	NAIRU estimates: This study (a) (2)	NAIRU estimates: Other studies (b)	
United States	1961-1969	4.7			4.8	5.9
	1967-1969	3.6	4.1	5.7		5.9
	1970-1973	5.4	6.0	5.4	6.0	5.8
	1974-1981	6.9	7.3	6.5	6.8	7.1
	1982-1983	9.7	4.2	6.1		6.8
Japan	1972-1975	1.5	1.2	1.2		
	1976-1980	2.1	1.9	1.9		
	1981-1983	2.2	2.3	2.3		
Germany	1967-1970	1.0	0.9	0.7	1.3	
	1971-1975	1.8	1.6	3.3	1.2	
	1976-1980	3.6	3.1	2.4	3.5	
	1981-1983	6.3	8.0	3.6	6.2	
France	1966-1970	2.1			2.2	
	1971-1975	2.7	4.6	4.5	3.3	
	1976-1980	5.2	3.3	4.8	5.2	
	1981-1983	8.3	9.0	7.7	6.9	
United Kingdom	1967-1970	2.2	2.6	7.1	2.4	
	1971-1975	3.0	7.2	4.2	4.0	
	1976-1980	5.4	7.3	7.6	4.7	
	1981-1983	10.6	5.9	9.4	9.2	
Italy	1966-1970	5.5	4.8	7.5	7.8	
	1971-1975	5.8	7.2	5.4	6.6	
	1976-1980	7.1	6.0	5.2	6.5	
	1981-1983	9.1	6.1	5.4	7.5	
Canada	1967-1969	4.2	3.8	6.4		
	1970-1973	5.9	4.1	4.7		
	1974-1979	7.2	7.2	5.8		
	1980-1983	8.5	6.9	7.4		
Austria	1969-1973	1.4	1.0	1.1		
	1974-1979	1.8	1.4	1.4		
	1980-1983	3.0	2.4	2.4		
Netherlands	1969-1973	2.5	2.2	3.0		
	1974-1979	5.2	5.4	4.5		
	1980-1983	9.3	10.6	8.7		

a. The NAIRU estimates in column 1 are calculated using the actual rate of growth of import prices; in column 2 they are calculated using the average rate of growth over the estimation period given in Table 1.

b. For the United States the source is Englander and Los (1983) in the first column and Braun (1984) in the second; for the other countries the source is Layard, et.al. (1984).

B. Comparisons of real and nominal wage flexibility

56. The concepts of real and nominal wage rigidity have been used with increasing frequency over the last few years to explain differing developments in unemployment, especially between Europe and the United States. In addition to being an important implication of the estimated wage equations, discussion of alternative measures of real and nominal wage rigidity provides an excellent framework within which cross-country comparisons can be highlighted. The discussion in this section is largely based on Grubb, Jackman and Layard (1983) ("Wage Rigidity and Unemployment in OECD Countries", European Economic Review).

57. In earlier articles, Sachs (1979) and Branson and Rotenberg (1980) focussed on the amount of nominal inertia in the system. With long (short) lags on past inflation in the wage equation, real wages will be flexible (rigid) in the face of an inflationary shock because nominal wages are rigid (flexible). Thus real wage rigidity is the opposite of nominal wage rigidity. These studies characterised the United States as having real wage flexibility and nominal wage rigidity due to the relatively long lags between inflation and wage changes, reflecting the practice of staggered three-year contracts in the unionised sector in the United States. Other major industrialised countries were characterised by real wage rigidity and nominal wage flexibility due to the greater degree of indexation of wages to prices. Given this definition, the estimated wage equations reported above would support the distinction between the United States and other countries.

58. Grubb, Jackman and Layard (hereafter GJL) (1983) and Gordon (1984) argue that the degree of nominal inertia in the wage equation is not sufficient to demonstrate the presence of real and/or nominal wage rigidity. Although real and nominal wage rigidity are supposed to explain unemployment developments, the above measures, for example, say nothing about how much unemployment will result from a given shock. GJL suggest a more appropriate measure of real wage rigidity is the increase in the unemployment rate required to offset the long-run inflationary consequences of a real shock, where a real shock is one that leads to a different equilibrium real wage (for example, a fall in productivity growth relative to trend or a shift in the terms of trade). In effect, this is a measure of the degree of non-accommodation necessary to maintain inflation constant in the face of an adverse shock. In the context of their model, real wage rigidity is simply the reciprocal of the semi-elasticity of wages with respect to a 1 percentage point increase in the unemployment rate (15), i.e. the long-run coefficient on the unemployment rate in a linear Phillips curve. Thus real wage rigidity will be higher the less responsive are nominal wages to the unemployment rate. A value of unity indicates that a 1 percentage point increase in the unemployment rate will offset a real shock which would otherwise result in a 1 per cent increase in inflation.

59. GJL also suggest that an appropriate indicator of nominal wage rigidity is given by the product of the above measure of real wage rigidity and the sum of the mean lag on inflation in the Phillips curve equation and the mean lag on wages in the price equations. Thus the longer are the lags in the wage and price equations, the greater will be nominal wage rigidity. If there are no lags, there will be no nominal wage rigidity, i.e. nominal wage rigidity requires some nominal inertia in the system. Given these definitions of real

and nominal wage rigidity, it is clear that they can co-exist, i.e. real wage rigidity does not imply nominal wage flexibility nor vice versa.

60. GJL's empirical results indicate a relatively high degree of nominal wage rigidity in the United States compared to other OECD countries, a result traceable to the relatively long lags in the United States wage equation. But in contrast to Sachs' and Branson and Rotenberg's results, the United States is not characterised by an unusually low degree of real wage rigidity compared to Europe. Of the countries studied in this paper, only the United Kingdom and Germany are estimated by GJL to have more rigid real wages than the United States; Italy and Australia about the same; and France, Canada, Austria, the Netherlands and especially Japan are all characterised as having greater real wage flexibility than the United States. These results make it somewhat difficult to attribute the more robust employment performance in the United States primarily to more flexible real wages.

61. A closely related measure of real wage rigidity was used in Economic Outlook 33 (July 1983, pp.48-49): real wage rigidity was defined in E.O. 33 as the short-run elasticity of nominal wages with respect to inflation minus the semi-elasticity of nominal wages with respect to the unemployment rate; GJL use the ratio of these two long-run elasticities. In fact, GJL's ratio of long- and short-run elasticities are the same because they impose the identical geometric lag structure on both the unemployment rate and inflation in their wage equation (i.e. they include a lagged dependent variable in their estimated equation). But if the lag structures on inflation and unemployment differ, as they do in the equations reported in Section II where there are no lags on the unemployment rate, then it may be more appropriate to consider the short- rather than the long-run elasticities. This is because, for a given real shock which increases price inflation, unemployment must increase so that in each period wage growth is restrained by the amount needed to offset the incipient wage increase in that period, not the long-run impact on wages. And unemployment must then remain high until the lagged impacts on wages are complete.

62. Estimates of real wage rigidity derived from the estimated equations reported in Table 1 are reported in Table 12. For those countries with a non-linear Phillips curve, the semi-elasticity of wages with respect to the unemployment rate will depend upon the level of the unemployment rate. The calculations in Table 12 use the average unemployment rate over the estimation period as well as the unemployment rate in the first half of 1984. The figures in Table 12 are not directly comparable to those in GJL because these estimates refer to semi-annual rates of change of an economy-wide (rather than manufacturing) wage measure and the mean lags are in terms of half years.

63. As none of the long-run inflation elasticities are significantly different from unity, the ratios of the long-run elasticities differ primarily because of the difference in the estimated unemployment semi-elasticities. Except for Japan and Australia the impact on wage inflation of a 1 percentage point increase in the unemployment rate is less than 0.6 per cent in all countries: for Canada, Italy and Austria the unemployment semi-elasticity is about 0.5 per cent and hence real wage rigidity is about 2; for the United States, Germany (at historical levels of the unemployment rate) and France it is about one-third per cent, giving a real wage rigidity of 3; and for the United Kingdom, the Netherlands and Germany (at current levels of unemployment) it is about 0.2 per cent or less, giving a real wage rigidity of

Table 12

REAL AND NOMINAL WAGE RIGIDITY

	Unem-ployment rate	Elasticity of nominal wages with respect to (a)			Real wage rigidity		Mean lag in the wage and price equations (c)	Nominal wage rigidity
		Prices		Unemployment rate (b)	Short run	Long run		
		Short run	Long run					
		1	2	3	4 = 1 ÷ 3	5 = 2 ÷ 3	6	7 = 4 x 6
United States		0.22	1.01	0.33	0.67	3.06	5.00	3.35
Canada		0.36	1 07	0.47	0.77	2.28	1.50	1.16
Japan	1.7 2 7	0.89	0.89	3.67 2.31	0.24 0.39	0.24 0.39	0.50	0.12 0.20
Australia (d)		0.45 0.33	0.90 0.66	1.78 0.48	0.25 0.69	 1.38	3.00	0.75 2.07
Germany (e)	2.7 8.5	0.44	0.88	0.25 0.08	1.76 5.50 0.58	3.52 11.00 0.61	2.00	3.52 11.00 1.16
France		0.47	0.94	0.31	1.52	3.03	3.00	4.56
United Kingdom		0.33	0.99	0.17	1.94	5.82	2.50	4.85
Italy		0.44	0.89	0.55	0.80	1.62	3.00	2.40
Austria	3.9 4.5	0.48	0.97	0.58 0.50	0.83 0.96	1.67 1.94	2.00	1.66 1.92
Netherlands	9.7 14.0	0.47	0.94	0.23 0.16	2.04 2.94	4.09 5.87	3.00	6.12 8.82

a. The elasticities are from the estimated wage equations reported in Table 1; the unemployment rate enters the wage equations unlagged.

b. For Japan, Germany, the Netherlands and Austria the estimated Phillips curves are non-linear and so the semi-elasticity of nominal wages with respect to a 1 percentage point increase in the unemployment rate is baseline dependent For these countries the semi-elasticity is calculated from the average unemployment rate in the estimation period (the first line) and also the unemployment rate in the first semester of 1984 (the second line).

c. The mean lag in the wage equation is 3.5 for the United States; 1.0 for Canada and the United Kingdom; 0 for Japan; and 0.5 for all other countries The lags in the price equations are reported in Table 15.

d. The first line is based on the equation which incorporates the hypothesis of hysteresis in the natural rate reported in Table 4, the second line is based on the standard Phillips curve reported in Table 1.

e. The estimates of wage rigidity reported in the third line incorporate a short-run productivity impact on nominal wages as discussed in paragraph 68 and Appendix C.

6 or more (but see the discussion of Germany below). In Australia, the hysteresis specification of the wage equation guarantees a semi-elasticity of zero in the long run and so the long-run measure of real wage rigidity is undefined. Japan stands out as the country where wage inflation responds most strongly to the unemployment rate, the unemployment semi-elasticity is about 3, and hence the measure of real wage rigidity is only about 0.3. This result, of course, is related to the very small movements of the Japanese unemployment rate over the estimation period.

64. These results, in terms of relative real wage rigidity, are similar to those reported in GJL except that they suggest that Italy and the Netherlands are characterised by, respectively, a much lower and higher degree of real wage rigidity. This difference may be attributable to a different cyclical responsiveness in these countries of manufacturing wages (used in GJL) compared to economy-wide wages. It is, of course, important to note that each country compiles its unemployment data differently, making international comparisons somewhat hazardous. This is especially true for Italy but may be equally important for other countries (16). Thus, in addition to reflecting different sensitivity of wages to unemployment, the diversity of the calculated real wage rigidity will also reflect different elasticities between real activity and the unemployment rate.

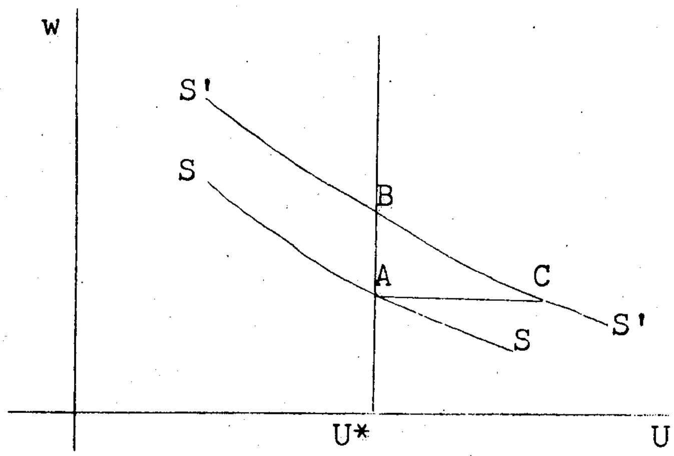
65. As argued above, the ratio of the short-run elasticities may be more interesting when inflation and unemployment have different lag structures. The difference between the indicators of real wage rigidity based on the short- versus the long-run elasticities is most apparent in the calculations for the United States. For the United States the long-run elasticity of nominal wages with respect to inflation is unity, although the short-run (half-year) impact is only 0.22; both the short- and the long-run semi-elasticity with respect to the unemployment rate is 0.33, i.e. there are no lags on the unemployment rate. Hence, in a long-run comparative-static sense, the unemployment rate would have to increase by 3 percentage points to offset a real shock which temporarily increased inflation by 1 per cent. If that temporary increase in inflation had its total effect in the first period, or alternatively if the increase in unemployment did not take place until the total effect on wages was complete (four years in the estimated equation), then an increase in the unemployment rate of 3 percentage points would be appropriate. But in the first period, the incipient increase in wages is only 0.22 and hence the unemployment rate would only have to increase by 0.67 percentage points to prevent an acceleration of wages.

66. Except for the United States and Japan past inflation enters as either a two or a three-semester moving average and hence the short-run inflation elasticity is either one-half or one-third of the long-run elasticity. For Japan, only contemporaneous inflation enters so the short- and the long-run elasticities are equal. When real wage rigidity is calculated as the ratio of the short-run elasticities regional differences emerge: Japan (and Australia with the hysteresis specification) has the lowest degree of real wage rigidity due to the high responsiveness of wages to unemployment; although somewhat higher than in Japan, North America also has relatively low real wage rigidity due to a slow response of wage growth to inflation (especially in the United States) combined with a relatively high responsiveness to unemployment (especially in Canada); for just the reverse reasons as North America -- relatively rapid indexation and low cyclical responsiveness -- Europe is in general characterised as having a higher degree of real wage rigidity, with

Italy and Austria being the most flexible of the European countries due to relatively high cyclical responsiveness of nominal wages.

67. The geometric interpretation in terms of a stylised Phillips curve analysis is as follows (Figure A). Starting from an initial equilibrium position A, consider a real shock such as a deterioration in the terms of trade. Since it is a real shock, the equilibrium level of real wages will fall and, with accommodating policies, inflation will increase. As the increase in inflation is incorporated into inflation expectations, the short-run Phillips curve SS will shift up, say to S'S' and, for an unchanged unemployment rate, inflation will stabilize at a permanently higher level at B. What is of interest here is the increase in unemployment which would be necessary to offset the increase in wages implied by the increased inflation, i.e. the degree of non-accommodation measured in terms of increases in the unemployment rate. In the figure, unemployment must increase from A to C. With unemployment above the natural rate (U*), wages decelerate thus offsetting the wage-price spiral which would otherwise have led to point B. The measures of real wage rigidity reported in Table 12 indicate that unemployment must increase (from A to C) only about 0.25 percentage points in Japan; about 0.7 percentage points in North America and slightly higher in Italy and Austria; and as much as 1.5 to 3 percentage points in France, the United Kingdom and the Netherlands.

Figure A



68. Calculations in Table 12 suggest that at current rates of unemployment, Germany is characterised by a very high degree of real wage rigidity. This is because the semi-elasticity of wages with respect to the unemployment rate becomes very low (0.08) on the far right-hand part of the non-linear Phillips curve. But these calculations do not allow for the short-run productivity impact on nominal wages which is the unusual feature of the estimated German wage equation. In all other countries, nominal wages are affected only by trend productivity which, since stable, is subsumed in the constant term. If unemployment changes to offset an incipient wage increase, it cannot be

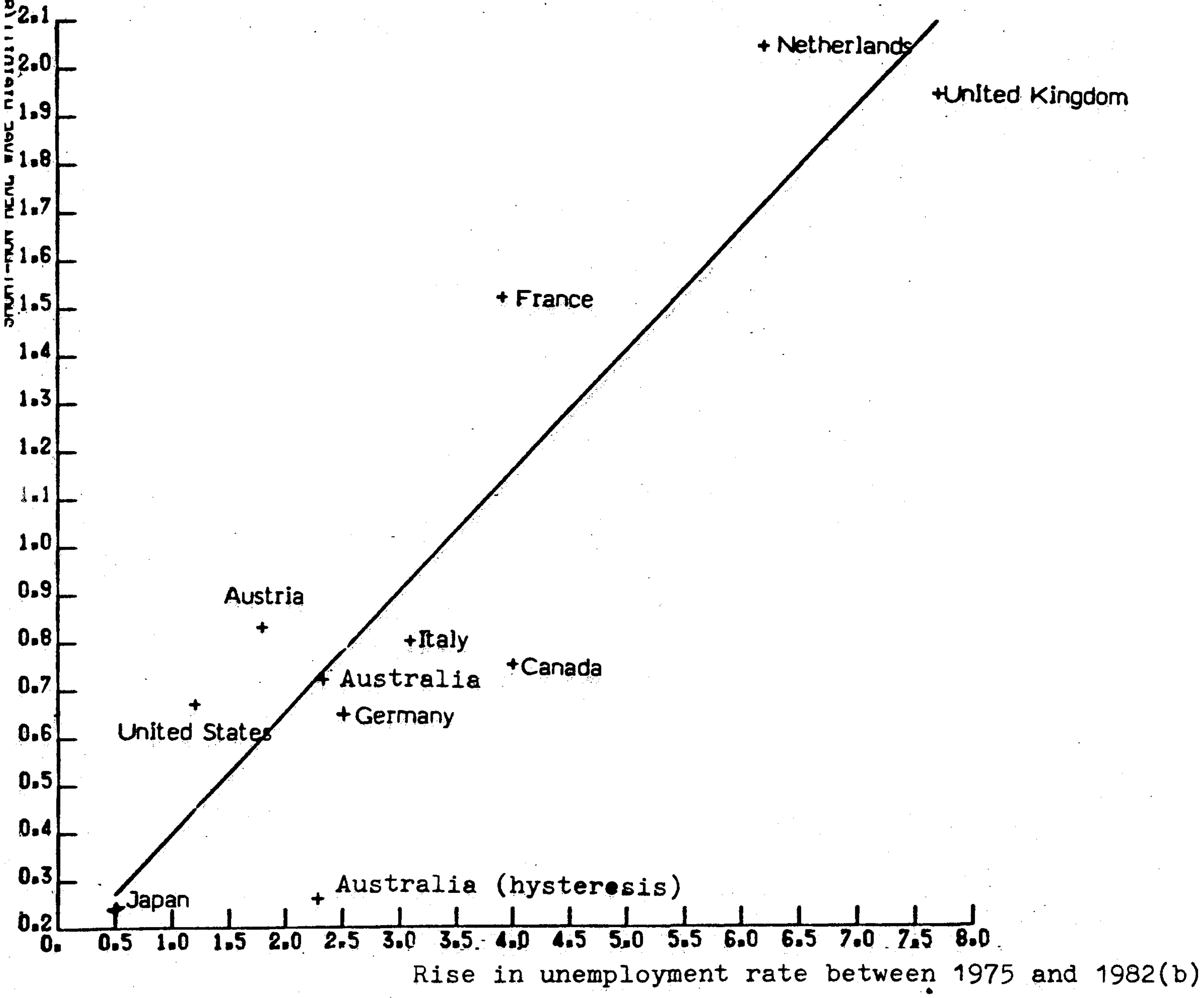
assumed that cyclical productivity remains unchanged. The presence of a cyclical productivity effect in the German wage equation means that the degree of real wage rigidity reported in the first two rows for Germany is overstated since the pro-cyclical movement of productivity will lower nominal wage increases and hence a smaller increase in unemployment will be necessary. In the Appendix it is estimated that the measure of real wage rigidity incorporating the cyclical productivity effect for Germany is about 0.5 to 0.6 depending on the level of the unemployment rate and whether the short- or the long-run elasticities are used.

69. If there were no lags in the system, the increase in unemployment would only have to last a single period. In this case, where there is no nominal inertia, the mean lags, and hence nominal wage rigidity, would be zero. But if wages respond to inflation with a lag, and vice-versa, unemployment will have to remain high as long as the inflationary consequences of the real shock are still working their way through the wage-price system. Nominal wage rigidity, defined as real wage rigidity multiplied by the sum of the mean lags in the wage and price equations, thus gives an indication of how long (the point-half-years) unemployment above the natural rate will be necessary to offset the inflationary consequences of the real shock. As shown in Table 12, Japan has the lowest degree of nominal as well as real wage rigidity; and due to the relatively long lags in the United States, nominal wage rigidity is considerably higher in the United States than in Canada, Germany, Australia, Italy and Austria but somewhat lower than in France, the United Kingdom and the Netherlands.

70. In Figure B the measures of short-run real wage rigidity as reported in Table 12 are plotted against the increase in the unemployment rate between 1975 and 1982. For Germany, the estimate which incorporates the cyclical productivity impact has been used. The graph suggests that real wage rigidity as measured above may be useful for understanding employment developments in different countries (17). It should be recalled, of course, that the measures of real wage rigidity are derived from the estimated wage equations, themselves a function of the unemployment rate. The results cast some doubt on the conventional wisdom that real wages are relatively flexible in the United States. The countries which stand out are Japan for relatively flexible real wages; and the United Kingdom and the Netherlands for relatively rigid real wages.

Figure B

SHORT-RUN REAL WAGE RIGIDITY AND UNEMPLOYMENT



a. As given in column 4 of Table 12; for Japan, Germany, Austria and the Netherlands, the average unemployment rate over the estimation period has been used.

b. Percentage points.

NOTES

1. For a summary of the Phillips curve literature see Santomero and Seater (1978) and Laidler and Parkin (1975).

2. See Santomero and Seater (1978) pp. 505-506 for references to the original literature. Grubb, et.al. (1983) present wage equations using vacancies as the only activity variable, but none with both vacancies and the unemployment rate.

3. In a survey of empirical studies in 1978 (p.506), Santomero and Seater report "that the weight of the evidence lies with a significant non-linear relation [between wage inflation and the unemployment rate]".

4. See Santomero and Seater, op. cit., pp. 503-504, 508.

5. See Kuh (1967) for an early United States study with just the change in the unemployment rate. Sumner and Ward (1983) report insignificant results for the change in unemployment in a recent study of wages in the United Kingdom.

6. See Buiter and Gersovitz (1981) and Grubb, et.al. (1983), who get empirical results consistent with this hypotheses. The analogous argument with respect to physical capital (the endogeneity of potential output) is common.

7. Specified in this way, hysteresis in the natural rate is essentially a (long lagged) change in the unemployment rate specification.

8. See Braun (1976) and Sachs (1979).

9. See Henry, et.al. (1976) and references cited therein, and Andersen (1984).

10. In this context an important role might be played by a progressive tax based on nominal income. Under such a tax regime, changes in disposable wages equal to changes in productivity, are inconsistent with a constant unit labour cost. This can be illustrated as follows where WD is the disposable wage, W the wage bill, T the tax on wages, and T/W the average tax rate:

$$WD = W - T = W(1-T/W).$$

Or, in terms of growth rates (lower-case mnemonics),

$$wd = w\,[1-(dT/dW)]/[1-(T/W)],$$

where dT/dW is the marginal tax rate. The rate of change of disposable wages (wd) is equal to the rate of change of nominal wages (w) only if dT/dW = T/W. But in a progressive income-tax regime, the marginal tax rate is greater than the average and so disposable wages grow more slowly than nominal wages. Assuming a continuous growth in productivity, and hence the target real disposable wage, the increasing gap between nominal and disposable wages may create a wage-tax spiral. To the extent that higher costs are shifted into prices, tax-push inflation will be the result.

11. Employers' contributions highlight the distinction between the wage concepts as seen from the employers' and the employees' viewpoint. This distinction is emphasized by studies (e.g. Wren-Lewis (1982)) which explicitly specify labour demand as being dependent on the post-tax product real wage (post-tax wages deflated by an output price) and labour supply as a function of the post-tax income real wage (post-tax wages deflated by a consumer price). Aside from the differing movements of employers' versus employees' wage taxes, the growth of the two concepts will diverge as i) the growth of government and investment prices differ from consumer prices, or their weight in total output changes, or ii) the terms of trade or the openness of the economy changes. Of these, changes in the terms of trade are likely to be the most important, especially in small open economies.

12. Profits are specified in two alternative ways: national accounts gross operating surplus as a share of GDP; and national accounts gross operating surplus relative to the gross capital stock, i.e. as a measure of the rate of return on capital. These measures of profits as well as the retention ratio (defined as the ratio of national accounts household disposable income to total income) and the tax rate for employers' contributions were entered alternatively in change, percentage change and logarithmic form.

13. In a recent study of wage determination in the United Kingdom, Sumner and Ward (1983) are also unable to find significant effects from lagged real wages. Andersen's (1984) results support the bargaining model for Germany and the United Kingdom. Von Beyme (1980), pp.75-76 reports the following data on trade union membership as a per cent of the labour force: Austria 60, the United Kingdom 50, Australia 50, the Netherlands 40, Germany 39, Japan 33, the United States 24, France 23 and Italy 22.

14. A recent textbook exposition with references is Johnston (1984).

15. A semi-elasticity since it refers to the percentage change in wages resulting from a 1 percentage point (not per cent) increase in the unemployment rate.

16. In Italy, workers in the Cassa Integrazione Guadagni, a public institution which pays the temporarily unemployed out of social security funds, are not counted as unemployed. If an unemployment rate adjusted for workers in the Cassa Integrazione Guadagni is used in the wage equation reported in Table 1, the unemployment semi-elasticity falls from 0.55 to 0.43. Other aspects of the equation deteriorate substantially.

17. If the measure of long-run real wage rigidity were used in Figure B, a clear positive relationship would still emerge, although the United States would be an outlier.

APPENDIX

A. Inflation equations

The reduced-form and time-series inflation equations, forecasts from which were used as a proxy for inflation expectations in Table 6, are reported in Tables 13 and 14.

B. Price coefficients

The price coefficients used to compute the NAIRUs reported in Table 11 are reported in Table 15.

C. Real wage rigidity from the German wage equation

The German wage equation from Table 1 is

$$w = 0.88 + 0.88p - 0.68\log(U) + 0.68q,$$

where w is wage growth, p inflation, U the unemployment rate and q productivity growth. (The two-period moving averages on p and q have been temporarily suppressed.) A real shock which increases p will increase w unless counteracted by an increase in U and/or a fall in q, i.e.,

$$dw = 0.88dp - (0.68/U)dU + 0.68dq. \qquad [A]$$

If dq = 0, then to offset a shock (dw = 0) leading to dp = 1, it is necessary that dU = 0.88/(0.68/U) = 11.0 as given in Table 12 column 5 for U = 8.5.

But in general for a change in unemployment, productivity will change. It will be useful to express dq in terms of dU to compute a measure of real wage rigidity consistent with those in Table 12. By definition, the change in productivity growth (dq) is equal to the change in real output growth (dy) minus the change in employment growth (de). Assuming an Okun coefficient of 2, meaning to reduce the unemployment rate by 1 per cent requires a change in the output gap of 2,

$$d(Y/YPOT) = -2dU.$$

where Y, YPOT are the level of real and potential GDPV, respectively. For Y approximately equal to an unchanged YPOT, the growth of Y (y) is,

$$y = -2dU$$
and $$dy = -2d^2U.$$

A transformation of the definition of the unemployment rate gives,

$$e = -dU/100 + f,$$

where e is employment growth, f is the growth of the labour force and the approximation $\log(1-U/100) = -U/100$ has been used. If a constant growth of the labour force (df=0) is assumed,

$$de = -(d^2U)/100.$$

Substituting dq = dy - de into equation [A],

$$\begin{aligned} dw &= 0.88dp - (0.68/U)dU + 0.68(-2d^2U + 0.01d^2U) \\ &= 0.88dp - (0.68/U)dU - 1.36d^2U. \end{aligned}$$

In discrete time, $\Delta\Delta U$ will be the same as ΔU in the period when the unemployment rate changes (after a period of stability). For a shock resulting in $\Delta p = 1$, and at U = 8.5, the increase in the unemployment rate necessary to prevent a change in wage inflation ($\Delta w = 0$) is $\Delta U = 0.88/(0.68/U + 1.36) = 0.61$, which is the long-run measure of real wage rigidity. The following table summarises the results for Germany comparable to those given in Table 12:

U	Real wage rigidity: Short-run	Real wage rigidity: Long-run	Nominal wage rigidity
2.7	0.47	0.55	0.94
8.5	0.58	0.61	1.16

D. Data definitions and sources

For all countries except the United States, Japan, Australia and Austria, the <u>wage</u> variable is constructed as the private sector national accounts wage bill per dependent employee in the private sector. For the United States the wage variable is the adjusted hourly earnings index for production workers in the non-farm business sector. For Japan it is the index of total wages and salaries, including bonus payments, per regular worker in all industries. For Australia it is wages in non-agricultural and public sector including private pension contributions and non-monetary income. For Austria it is the total national accounts wage bill per dependent employee.

Prices are the implicit National Accounts deflator for private consumption expenditures.

The unemployment rate, which is based on national definitions, is total unemployed as a percentage of the civilian labour force. Productivity is defined as real GDP divided by total employment.

For most countries the average tax rate is defined as the sum of direct taxes on households and total social security contributions (both employees' and employers') as a percentage of total household income. For Germany and the Netherlands it is defined as the sum of total taxes on wage income and employees' social security contributions as a per cent of total household income. The employers' contribution tax rate is defined as the sum of employers' contributions for social security and private pensions and insurance as a per cent of total employees' compensation.

Profits were defined as national accounts gross operating surplus as a per cent of GDP and also as the gross operating surplus as a per cent of the gross capital stock, i.e. as a measure of the rate of return on capital.

Data sources are OECD, National Accounts and Quarterly Labour Force Statistics as well as individual country national accounts.

Table 13

REDUCED-FORM INFLATION EQUATIONS (a)

$$p = c0 + c1.p_{-1} + c2.m_{-i} + c3.pm_{-1} + c4.e_{-1} + c5(U-U_{-1}) + c6.NLG_{-1} + c7.DOIL1 + c8.DOIL2$$

	c0	c1	c2 (b)	c3	c4	c5 (c)	c6	c7	c8	R^2	h-stat	SEE	Fit period
United States	0.04 (0.2)	0.77 (11.9)	0.12 (2.1)		-0.07 (3.5)	-0.12 (1.0)		0.91 (2.6)	0.79 (2.2)	0.90	-0.01	0.44	61II-83I
Japan	-0.40 (0.6)	0.42 (4.7)	0.28 (3.8)	0.05 (2.5)				5.85 (6.1)		0.87	1.09	0.84	66II-82II
Germany	0.17 (0.5)	0.72 (7.0)	0.14 (3.1)			-0.26 (1.5)	-0.02 (1.5)			0.64	-1.98	0.55	62II-82I
France (d)	-0.27 (0.4)	0.77 (9.0)	0.17 (2.0)						1.38 (2.3)	0.77	-0.17	0.82	65II-82II
United Kingdom	1.14 (1.8)	0.38 (2.8)	0.23	0.10 (1.6)		-0.52 (1.0)	-0.40 (2.4)		1.99 (1.7)	0.75	-0.28	1.42	66II-82II
Canada	0.02 (0.1)	0.82 (12.1)	0.08 (2.2)			-0.27 (1.9)		0.99 (2.1)		0.89	-0.65	0.62	57II-83I

a. Definitions: p is growth of the private consumption deflator; m is money stock (M1) growth; pm is import prices growth; e is employment growth; U is the unemployment rate; NLG is net lending of government as a per cent of GDP; DOIL1 is a dummy variable equal to 1.0 in 74I and II and zero elsewhere; DOIL2 is a dummy variable equal to 1.0 in 79II and 80I and zero elsewhere.

b. Lagged four semesters for the United States and France; separate two and three-semester lags for the United Kingdom with estimates coefficients of 0.08 (t-statistic 1.2) and 0.15 (2.0); two-semester lags for Japan and Canada; and one-semester lag for Germany.

c. The level of the unemployment rate for Germany.

d. Includes a dummy variable for the events of 1968 with an estimated coefficient of 1.9 (2.2).

Table 14

ARIMA INFLATION EQUATIONS

$$p = d1.p_{-1} + d4.p_{-4}$$

	d1	d4	χ^2 (a)	Degrees of freedom
United States (b)	0.17 (1.2)	-0.39 (2.7)	3.36	7
Japan	0.92 (16.4)		5.69	6
Germany (b)	-0.45 (3.3)		7.49	8
France	0.95 (38.7)		3.18	7
United Kingdom	0.95 (19.6)		5.31	8
Canada	0.98 (32.2)		9.66	8

a. χ^2-statistic for test of the hypothesis that the errors are white noise.

b. First differences of the inflation terms.

Table 15

WAGE AND PRICE COEFFICIENTS FOR NAIRU ESTIMATES

$$w = a0 + a1.pe \begin{pmatrix} -a21.U \\ -a22 \log(U) \end{pmatrix} + a3.q + a4.wmin$$

$$p = b0 + b1(w+s-q) + b2.pm + b3.GAP$$

											Lag length in price equation		
	a0	a1	a21	a22	a3	a4	b0	b1	b2	b3	w	q	pm
United States	2.57	1.00	-0.33			0.01	-11.7	0.89	0.16	12.5	4	4	4
Japan	5.96	0.89		-6.22			-11.4	0.58	0.10	13.8	2	2	6
Germany	0.88	0.88		-0.68	0.68		-6.8	0.52	0.31	7.8	4	6	4
France	2.36	0.94	-0.31			0.11	-20.9	0.56	0.25	23.1	6	4	4
United Kingdom	2.13	0.99	-0.17				-18.5	0.90	0.26	19.4	4	6	0
Italy	5.63	0.89	-0.55					0.65	0.35		6	4	3
Canada	3.58	1.09	-0.48				-0.7	0.63	0.26		2	4	2
Austria	2.52	0.97		-2.27				0.58	0.32		6	6	3
Netherlands	4.92	0.94		-2.24				0.55	0.36		4	4	3

Note: The "a" coefficients are from the text. The "b" coefficients are from the INTERLINK price equations. pe is defined in Table 1 note b, wmin is the growth of minimum wages, GAP is the ratio of actual real GDP to potential real GDP where the latter is determined in the supply block of the INTERLINK model.

REFERENCES

Andersen, P.S. (1984), "Real Wages, Inflation and Unemployment", BIS Working Papers, No.9 (July).

Artus, P. (1983), "Formation conjointe des prix et des salaires dans cinq grands pays industriels : peut-on comprendre les écarts entre les taux d'inflation?", Annales de l'INSEE.

Branson, W.H. and Rotenberg, J.J. (1980), "International Adjustment with Wage Rigidity", European Economic Review (May), pp.309-332.

Braun, A.R. (1976), "Indexation of Wages and Salaries in Developed Economies", IMF Staff Papers (March), pp. 226-71.

Braun, S. (1984), "Productivity and the NIIRU (And Other Phillips Curve Issues)", Working Paper No.34, Board of Governors of the Federal Reserve System (February).

Buiter, W.H. and Gersovitz, M. (1981), "Issues in Controllability and the Theory of Economic Policy", Journal of Public Economics (February), pp. 33-43.

Englander, A.S. and Los, C.A. (1983), "Recovery Without Accelerating Inflation", Quarterly Review, Federal Reserve Bank of New York (Summer), pp. 19-28.

Friedman, M. (1968), "The Role of Monetary Policy", American Economic Review (March), pp. 1-17.

Gordon, R.J. (1984), "Wage Price Dynamics and the Natural Rate of Unemployment in Eight Large Industrialised Nations", paper presented at the OECD Workshop on Price Dynamics.

Grubb, D., Jackman, R. and Layard, R. (1983), "Wage Rigidity and Unemployment in OECD Countries", European Economic Review (March/April), pp. 11-39.

Henry, S.C.B., Sawyer, M.C. and Smith, P. (1976), "Models of Inflation in the United Kingdom: An Evaluation", National Institute of Economics Review.

Johnston, J. (1984), Econometric Methods, 3rd ed., McGraw Hill.

Kuh, E. (1967), "A Productivity Theory of Wage Levels -- An Alternative to the Phillips Curve", Review of Economic Studies (October), pp. 333-60.

Laidler, D.E.W. and Parkin, M. (1975), "Inflation: A Survey", Economic Journal (December), pp. 741-809.

Layard, R., Basevi, G., Blanchard, O., Buiter, W. and Dornbusch, R. (1984), "Europe: the Case for Unsustainable Growth", Center for European Policy Studies (No.8/9).

Modigliani, F. and Tarantelli, E. (1976), "Forze di Mercato Azione Sindacale, e la Curva di Phillips in Italia", Moneta e Credito (June).

Robertson, H. and McDougall, M., "The Structure and Dynamics of RDXF, September 1980 Version", Bank of Canada Technical Report 26, pp. 119-23.

Sachs, J. (1979), "Wages, Profits and Macroeconomic Adjustment: a Comparative Study", Brookings Papers on Economic Activity (No.2), pp.269-333.

Santomero, A.M. and Seater, J.J. (1978), "The Inflation-Unemployment Trade-off: A Critique of the Literature", Journal of Economic Literature (June), pp. 499-544.

Sumner, M.T. and Ward, R. (1983), "The Reappearing Phillips Curve", Oxford Economic Papers, Special Supplement (November), pp. 306-20.

Thirlwall, A.P. (1983), "What are Estimates of the Natural Rate of Unemployment Measuring?", Oxford Economic Bulletin of Economics and Statistics (May), pp. 173-79.

Von Beyme, K. (1980), Challenge to Power: Trade Unions and Industrial Relations in Capitalist Countries, Sage Publications (London).

Wallis, K.F. (1980), "Econometric Implications of the Rational Expectations Hypothesis", Econometrica (January), pp. 49-73.

Wickens, M.R. (1982), "The Efficient Estimation of Econometric Models with Rational Expectations", Review of Economic Studies (January), pp. 55-68.

Woodham, D.M. (1984), "Potential Output Growth and the Long-term Inflation Outlook", Quarterly Review, Federal Reserve Bank of New York (Summer), pp. 16-23.

Wren-Lewis, S. (1982), "A Model of Private Sector Earnings Behaviour", Treasury Working Paper No.23 (July), H.M. Treasury.