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Unemployment and wage formation in small industrial countries (1973-1989)

A. Van Poeck

J. Van Gompel

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Universitaire Faculteiten St.-Ignatius

Prinsstraat 13 - B 2000 Antwerpen

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Abstract.

In this paper we assess the role of wage formation for the evolution of unemployment in eleven small industrial economies during the period 1973-89. We consider several measures of real and nominal wage rigidity and relate these measures to the change in unemployment in order to test the relationship between the characteristics of wage formation and macroeconomic performance under different kind of shocks experienced during the period.

The main outcome is that wage formation goes a long way in explaining the unemployment experience of these countries during the 1970s, but that the relationship breaks down in the 1980s and especially in the period following the positive oil price shock of 1986.

1. Introduction.

In this paper we assess the role of wage formation for the evolution of unemployment in a number of small open industrial economies in the 1970s and the 1980s [1]. We show that wage formation goes a long way in explaining the unemployment experience of these countries during the 1970s, but that the relationship breaks down during the 1980s and especially in the period following the favourable oil price shock of 1986.

As a starting point we look at the evolution of unemployment in eleven small open economies. The main observation is that, although the labour market performance of these economies has been rather similar over the years, there is a great diversity of national experiences in the sense that the intensity of the unemployment problem has been quite different between these countries.

Table 1 illustrates the point. In this table we show the increase (or decrease) of unemployment for three subperiods, viz. between 1973 and 1979, between 1979 and 1986, and between 1986 and 1989. The choice of these periods is based on the following

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[1] This analysis is part of a larger research project which aims at explaining the differences in the macroeconomic performance of small open economies, with special emphasis on the stance of their macroeconomic policies and on differences in their supply side characteristics. The countries included are: Austria, Australia, Belgium, Denmark, Finland, Ireland, the Netherlands, New Zealand, Norway, Sweden and Switzerland.

Table 1. Evolution of unemployment in eleven small industrial countries (as a % of the labour force).

country	1979/1973	1986/1979	1989/1986
Australia	+3.9	+1.8	-1.9
Austria	+0.8	+1.4	+0.3
Belgium	+5.1	+4.1	-2.3
Denmark	+5.2	+1.6	+1.5
Finland	+4.4	-0.6	-1.9
Ireland	+1.4	+10.3	-1.9
Netherlands	+2.1	+5.7	-1.8
New Zealand	+1.7	+2.1	+3.2
Norway	+0.4	+0.1	+3.0
Sweden	-0.3	+0.5	-0.8
Switzerland	+0.3	+0.4	-0.1
Average (unweighted)	+2.3	+2.5	-0.2

Source: OECD, Economic Outlook 47, June 1990, table R19.

consideration. During the first period, the OECD economies were hit by a combination of a negative supply shock (first oil price shock, decrease in labour productivity) and a positive demand shock. Monetary and fiscal policy were loose in an attempt to counter the deflationary consequences of the first oil price shock. The second period could be considered as one which combines a negative supply shock (second oil price shock) with a negative demand shock. Monetary and fiscal policy turned more restrictive, as it became clear that the resulting inflation and the consequences for government financial balances made the policy stance of the 1970s unsustainable [2]. The last period combines a positive supply shock (oil price decrease and decreasing or low prices of basic raw materials) with a negative demand shock, the stance of monetary and fiscal policy remaining firm [3]. Some key figures with respect to monetary and fiscal policies in the countries considered are shown in table 2a (monetary policy) and 2b (fiscal policy).

Table 1 confirms the statement that was made above. Between 1973 and 1979, as well as between 1979 and 1986, ten out of the eleven small countries that constitute our sample, experienced an increase of unemployment, the average increase being 2.3 and 2.5 percentage points respectively. Over the last period there is a

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[2] To be sure, in most countries it took until 1982 or 83 for fiscal policy to become restrictive.

[3] A notable exception with respect to fiscal policy is Norway, where variations in the oil revenues have a large effect on the budget balance.

Table 2a. Average short-term and long-term interest rates (real, delated by CPI).

Money market interest rates.

country	1974-79	1980-86	1987-89
Australia	-3.93	3.76	6.14
Austria	-0.18	2.85	1.01
Belgium	-1.65	3.37	3.94
Denmark	1.34	5.00	4.73
Finland	-	4.93	7.29
Ireland	-2.34	2.54	6.28
Netherlands	-0.65	3.56	5.18
New Zealand	-	-	-
Norway	-0.21	3.61	6.16
Sweden	-1.70	3.36	4.79
Switzerland	-1.64	-1.09	1.58
Average	-1.22	3.19	4.71

Government bond yield.

country	1974-79	1980-86	1987-89
Australia	-2.48	5.14	5.37
Austria	2.46	4.08	4.95
Belgium	0.37	5.51	6.14
Denmark	3.33	7.49	6.47
Finland	-	-	-
Ireland	-0.68	2.56	6.77
Netherlands	1.43	5.00	6.26
New Zealand	-5.10	1.02	4.59
Norway	-1.01	3.38	5.79
Sweden	-0.41	3.33	-
Switzerland	0.87	1.02	2.32
Average	-0.12	3.85	5.41

Source: IMF, International Financial Statistics, Yearbook 1989 and June 1990 (lines 60b, 61 and 64).

Table 2b. Cyclically-adjusted budget balances based on a trend output benchmark (changes as a per cent of trend GNP/GDP; period averages).

country	1974-82	1983-86	1987-89
Australia	0.36	-1.20 (-0.71)	0.70 (+1.12)
Austria	-0.29	-0.27 (+0.27)	-0.27 (-0.23)
Belgium	-0.32	+0.40 (+1.31)	-0.03 (-0.04)
Denmark	-1.18	+1.93 (+1.77)	-0.20 (-0.01)
Finland	-0.62	-0.25 (+0.42)	-0.20 (-0.19)
Ireland	-1.14	+2.60*(+2.00)	+1.90 (+2.01)
Netherlands	-0.20	+0.20 (+0.17)	+0.07 (+0.03)
New Zealand	-	- (-)	- (-)
Norway	-0.10	-2.20 (-0.39)	-2.23 (-1.77)
Sweden	-0.74	+0.85 (+1.04)	+1.13 (+1.25)
Switzerland	-	- (-)	- (-)
Average	-0.47	+0.23 (+0.65)	+0.10 (+0.24)

* 1983-84

Source: Price, R.W. & Muller, P. (1984), table 6, and OECD, Economic Outlook, various issues. The figures between brackets are taken from a more recent study: Chouraqui, J.-C., Hagemann, R.P. & Sartor, N. (1990), table 4.

decrease of unemployment for seven out of the eleven countries (the average decrease is 0.2 percentage points).

The diversity of national experiences is illustrated by comparing the national performances with the group average. It is readily seen, then, that during the first period, unemployment rose more sharply (as compared to the group) in Denmark, Belgium, Finland and Australia. During the second period, relatively weak performances are realized by Ireland, the Netherlands, and Belgium again. In the last period, finally, New Zealand, Norway and Denmark had a relatively unsuccessful unemployment record.

At the side of the countries with a relatively strong performance, the picture exhibits more stability, at least when the first and the second period are compared. The countries that performed well during the first period (Austria, Norway, Sweden and Switzerland [4]), also did so during the second period, when they were joined by Denmark and especially Finland. However, during the last period the group of countries with the best performance is made up of a completely different set of countries: Belgium, Finland, Ireland, Australia and the Netherlands.

It should be stressed that the above classification is based on

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[4] According to OECD (1989, p. 29) the flexible supply of immigrant workers is an important element in explaining the low unemployment in Switzerland.

comparing individual country performances with the group average, for absolute changes in the unemployment rate. These differences are usually not large enough to significantly shake up the ranking (relative positions) of the countries concerned, when period averages for the level of unemployment are considered (see A. Van Poeck & J. Van Gompel (1989)). Nevertheless, they are important enough to merit particular attention.

2. The wage formation process.

During the last decade a number of leading articles were published that paid much attention to the role of wage formation and labour market flexibility for macroeconomic performance in general, and for the evolution of employment and unemployment in particular. See e.g. Grubb et al. (1983), Coe (1985), Klau & Mittelstädt (1986), Chan-Lee et al.(1987).

These studies were generally made with the adverse real shocks of the 1970s at the back of the mind. They consequently stressed the importance of real wage flexibility. However, as mentioned above, since 1973 the OECD economies experienced a sequence of different shocks. Table 3 indicates which type of wage flexibility is needed to minimize the increase in unemployment (maximize the increase of employment) if the economy is hit by such different shocks. Real wage flexibility e.g. is expected to moderate the increase of unemployment in the event of an adverse supply shock (and to strenghten the employment consequences of a positive demand shock). But, in the case of a positive supply shock or a negative demand shock, nominal wage flexibility is expected to improve labour market performance, since these shocks normally imply a decrease in price inflation.

The concepts of nominal and real wage rigidity have been related to the parameters of a macroeconomic wage equation that has to be

Table 3. 'Optimal' combination of type of wage flexibility and kind of economic shock.

	real wage flexibility	nominal wage flexibility
supply shock		
positive		+
negative	+	
demand shock		
positive	+	
negative		+

estimated. Such key parameters are [5]:

(a) the short-run responsiveness of nominal wages with respect to prices;

(b) the sensitivity of wages to the unemployment rate;

(c) the sensitivity of wages to cyclical productivity growth;

(d) the sensitivity of wages to the terms of trade.

Wage formation is then characterized by a high degree of real wage flexibility if the responsiveness of nominal wages with respect to prices is low and the sensitivity of (nominal and real) wages to the unemployment rate is high. If cyclical productivity growth or changes in the terms of trade have a significant impact on wage growth this further increases the degree of real wage flexibility. If, on the contrary, the sensitivity to prices, as well as the sensitivity to unemployment (and in that event to cyclical productivity growth and changes in the terms of trade) are all high, wages are said to exhibit nominal flexibility.

In this paper we follow this approach. Hence, we estimate an equation for nominal wage growth which takes the following form:

$$\dot{w} = a_0 + \gamma.[\ \dot{p}_c + a_1.(\dot{p}_y - \dot{p}_c)\ ] + a_2.u + a_3.\dot{q}$$
$$+ a_4.[\ t_w/(1-t_w)\ ].\dot{t}_w + a_5.[\ t_p/(1+t_p)\ ].\dot{t}_p + (1-\gamma).\dot{w}_{-1}$$

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[5] See e.g. OECD (1989).

with $\dot{w}$: growth rate of gross nominal wages;

$\dot{p}_c$: growth rate of consumer prices;

$\dot{p}_y$: growth rate of value added prices (GDP deflator);

u : unemployment rate;

$\dot{q}$: cyclical productivity growth;

t_w : income tax rate of employees (defined as direct taxes on employees' income + employees' social security contributions as a percentage of gross wages and salaries);

t_p : employers' contributions for social security and private pensions and welfare plans as a percentage of gross wages and salaries);

$\dot{t}_w$ and $\dot{t}_p$: growth rates of t_w and t_p.

The theoretical foundation and the derivation of the above wage equation are given in the appendix of this paper. The equation differs from the well-known wage equations estimated by Grubb et al. (1983) and Coe (1985; OECD (1989b) p.44) in that the terms-of-trade effect (growth rate of GDP deflator minus growth rate of consumer prices) and the employees' and employers' tax rate and rate of contribution for social security are systematically included as explanatory variables. This also has implications for the computed measures of real and nominal wage flexibility.

The complete results from an estimation of the nominal wage equation for the 11 small open economies, using OLS and yearly data covering the period from the beginning of the 1960s to 1987

(in most cases), are also shown in the appendix. Table 4 gives a summary of the estimated parameters, together with the measures of real and nominal wage flexibility that are derived from them.

We briefly discuss the main results. Consider first the parameter γ which reflects the short run responsiveness of nominal wages to prices. This parameter is only significantly lower than one for two countries, viz. Sweden and Austria, implying that in most of the small open economies considered, nominal wages quickly adapt to prices. As shown by the estimated values for the parameter a_1, changes in the terms of trade exert a strong influence on wage growth in Sweden, the Netherlands, Denmark and Austria, implying e.g. that in the event of a negative oil price shock (which increases $\dot{p}_c$ without affecting $\dot{p}_y$), nominal wages will roughly remain unchanged in these countries [6]. In Australia, Finland and Norway, on the contrary, the evolution of wages does not take account of changes in the terms of trade, so that in the event of a negative oil price shock nominal wages (and hence real wages in terms of value added prices) increase sharply.

The parameter a_2 is significant for all the countries of the sample. It is largest (in absolute value) for Norway, Sweden, Finland and Switzerland. In Belgium, Denmark, Ireland and the Netherlands, on the contrary, the results point to a very weak influence of slack labour market conditions on the growth rate of

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[6] If $a_1 = 1$ nominal wages are de facto indexed to value added prices; if $a_1 = 0$ they are indexed to consumer prices.

Table 4. Parameters of the nominal wage equation and measures of wage rigidity.

country	γ	a_1	a_2	a_3	a_4	a_5
Australia	0.95	(0.23)	-0.61	(0.32)	-	-
Austria	0.62	0.85	-0.67	0.59	(-0.06)	-1.91
Belgium	1.01	0.58	-0.48	0.42	(-0.17)	(-0.79)
Denmark	1.04	0.91	-0.40	(0.23)	-	-
Finland	1.05	(0.18)	-1.11	0.59	(0.04)	(-1.08)
Ireland	1.28	0.28	-0.32	0.39	-	-
Netherlands	0.97	1.33	-0.27	(0.22)	-	-
New Zealand	0.82	0.58	-0.84	(0.30)	-	-
Norway	0.74	(-0.12)	-1.81	0.50	-	-
Sweden	0.57	1.35	-1.37	0.70	(0.01)	(-0.08)
Switzerland	1.04	0.75	-1.05	0.61	0.26	(-1.10)

Figures are put between brackets if the estimated coefficient is statistically not significantly different from zero.

	real wage rigidity			nominal wage rigidity		
country	RWR1	RWR2	RWR3	NWR1	NWR2	NWR3
Australia	1.56	1.56	1.56	0.64	0.64	0.64
Austria	0.93	0.49	0.29	0.78	0.53	0.37
Belgium	2.10	1.12	0.68	0.67	0.52	0.40
Denmark	2.60	2.60	0.79	0.69	0.69	0.43
Finland	0.95	0.62	0.62	0.46	0.36	0.36
Ireland	4.00	1.80	1.29	0.63	0.50	0.44
Netherlands	3.59	3.59	0.60	0.81	0.81	0.39
New Zealand	0.98	0.98	0.58	0.60	0.60	0.45
Norway	0.41	0.32	0.32	0.39	0.33	0.33
Sweden	0.42	0.28	0.17	0.52	0.38	0.25
Switzerland	0.99	0.63	0.43	0.48	0.37	0.29
Average	1.68	1.27	0.67	0.61	0.52	0.40

wages. None of the small open economies turns out to suffer from hysteresis, however.

The sensitivity of wages to cyclical productivity growth, as measured by a_3, also differs strongly between countries. It is high (but lower than one) in Sweden, Switzerland, Austria and Finland and low (not significantly different from zero) in Australia, New Zealand, Denmark and the Netherlands.

Because of the data availability the coefficients a_4 and a_5 could only be estimated for a limited number of small countries. The results show that gross nominal wage growth is invariant for changes in the income tax rate of employees in Austria, Belgium, Finland and Sweden. Only in Switzerland does a change in the employees' income tax rate affect gross wages. In Austria, an increase in the employers' rate of contribution for social security is compensated by a decrease in gross wage growth, which exerts a moderate influence on the growth rate of total compensation. For Belgium, Finland, Sweden and Switzerland such a compensating mechanism is not found.

The estimated parameters of the wage equation are used to derive measures of real and nominal wage rigidity. We use several measures of real and nominal wage rigidity, viz.[7]

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[7] Since the coefficients a_4 and a_5 could only be estimated for a limited number of small open economies they are left out of account for the computation of the measures of real and nominal wage rigidity.

RWR1 = $\gamma / \lvert a_2 \rvert$	NWR1 = $1 / (\gamma + \lvert a_2 \rvert)$
RWR2 = $\gamma / (\lvert a_2 \rvert + a_3)$	NWR2 = $1 / (\gamma + \lvert a_2 \rvert + a_3)$
RWR3 = $\gamma / (a_1 + \lvert a_2 \rvert + a_3)$	NWR3 = $1 / (\gamma + a_1 + \lvert a_2 \rvert + a_3)$

The derivation of these measures is straightforward. RWR1 refers to the traditional measure of real wage rigidity used by Grubb et al. (1983) and Coe (1985), viz. the short-run elasticity of nominal wage to prices divided by the semi-elasticity of wages to unemployment. The indicator RWR2 takes into account the sensitivity of wages to cyclical productivity growth. A high sensitivity of wages to cyclical productivity decreases the measured degree of real wage rigidity. RWR3 further takes into account the sensitivity to changes in the terms of trade (if wages are sensitive to changes in the terms of trade this further increases real wage flexibility).

Contrary to Grubb et al. (1983) and Coe (1985) our measures of nominal wage rigidity are based solely on the parameters of the estimated wage equation. The difference between nominal and real flexibility lies in the role of the parameter γ , i.e. the short run responsiveness of nominal wages to prices. If the short-run responsiveness of nominal wages with respect to prices is high, real wages will be rigid, but nominal wages flexible. In that sense nominal wage rigidity is the opposite of real wage rigidity, as originally defined by Sachs (1979). However, the other parameters should also be included in the measure of nominal wage rigidity. The meaning of these parameters for

nominal wage rigidity is the same as for real wage rigidity.

Turning to the results for the measurement of real and nominal wage rigidity, it can be seen from table 4 that Austria, Finland, New Zealand, Norway, Sweden and Switzerland exhibit a relatively low degree of real wage rigidity for all three measures. Denmark and Ireland, on the contrary, show a relatively high degree of real wage rigidity for the three measures. For the remaining countries (Australia, Belgium and the Netherlands) the picture is less clear. Turning to nominal wage rigidity this is found to be low for Finland, Norway, Sweden and Switzerland. Australia and Denmark, on the other hand, exhibit a relatively high degree of nominal wage rigidity. Again, for the remaining countries (Austria, Belgium, Ireland, the Netherlands and New Zealand) some measure indicates at high nominal wage rigidity, whereas another points to low nominal wage rigidity.

Table 5 shows Spearman rank order correlation coefficients between the various measures of real and nominal wage rigidity. As can be seen, the correlation coefficients are generally high, with some notable exceptions however, indicating that the rankings of the countries with respect to the different measures are fairly close to each other. Only the correlation coefficient between NWR1 and NWR3 does not seem to be significantly different from zero at the 5% level. Notice also that both a relatively high degree of real and nominal wage flexibility is found for Finland, Norway, Sweden and Switzerland.

Table 5. Spearman rank correlation coefficients between the various measures of real and nominal wage rigidity.

RWR2	RWR3	NWR1	NWR2	NWR3	
0.95	0.78	0.60	-	-	RWR1
-	0.79	-	0.78	-	RWR2
-	-	-	-	0.84	RWR3
-	-	-	0.85	0.48	NWR1
-	-	-	-	0.70	NWR2

The critical values for the Spearman rank order correlation coefficient are 0.536 and 0.709 at the 5% and 1% level, respectively.

3. Wage rigidity, shocks and the evolution of unemployment.

In this section we relate the various measures of wage rigidity to the change in unemployment in order to test the relationship between the characteristics of wage formation and macroeconomic performance that was postulated in table 3.

As mentioned in the introduction, during the period 1973-79 the economies experienced a combination of a negative supply shock and a positive demand shock. Countries with a high (low) degree of real wage rigidity were in a bad (good) position under both kind of shocks. We therefore expect them to have poorer (better) unemployment results. The last period 1986-89 combines a positive supply shock with a negative demand shock. In the case of such shocks nominal wage flexibility becomes important (see table 3). Countries that exhibit a high (low) degree of nominal wage rigidity are expected to perform worse (better) on unemployment. The period 1979-86 can be considered as an in-between-case. Indeed, confronted with a combination of a negative supply shock and a negative demand shock, we expect countries with both a low degree of real and nominal wage rigidity to have better unemployment results.

In table 6 we show Spearman rank order correlation coefficients between the various measures of wage rigidity and the change in

Table 6. Spearman rank correlation coefficients between the measures of wage rigidity and the change in unemployment.

	1973-79	1979-86	1986-89
RWR1	0.59	0.83	-0.41
RWR2	0.68	0.76	-0.32
RWR3	0.75	0.53	-0.46
NWR1	0.43	0.69	-0.21
NWR2	0.54	0.69	-0.06
NWR3	0.67	0.68	-0.10

	1973-82	1982-86
RWR1	0.78	0.44
RWR2	0.82	0.36
RWR3	0.75	0.38
NWR1	0.63	0.12
NWR2	0.63	0.23
NWR3	0.70	0.43

The critical values for the Spearman rank order correlation coefficient are 0.536 and 0.709 at the 5% and 1% level, respectively.

unemployment [8]. It can be seen that for the first period the rank order correlations between the three measures of real wage rigidity and the change in unemployment are fairly high (0.59, 0.68 and 0.75, respectively). Indeed, Austria, New Zealand, Norway, Sweden and Switzerland all have a high degree of real wage flexibility and perform relatively well on unemployment. The notable exception is Finland where a low degree of real wage rigidity is combined with a fairly large unemployment increase in the 1973-79 period. Australia, Belgium, Denmark, and the Netherlands, on the contrary, each showing higher values for the three measures of real wage rigidity, perform clearly worse. Again, there is one notable exception. Ireland which exhibits a high degree of real wage rigidity performs relatively well on the change in unemployment, during this period. The correlation coefficients between the measures of nominal wage rigidity and the change in unemployment are low for two out of the three measures, which is in line with the presupposed relationship.

For the second period we find high Spearman rank correlation coefficients for real and nominal wage rigidity as well. This observation is also in line with the presupposed relationship that was set out in table 3. To be sure, the correlation coefficients are higher for the measures of real wage rigidity than for nominal wage rigidity. Finland, Norway, Sweden and

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[8] The rankings for wage rigidity are built from low to high values. For changes in unemployment the ranking of countries are built from high decreases to high increases.

Switzerland all show a relatively low degree of real and nominal wage rigidity and perform relatively well on unemployment during this period. Australia, Belgium, Ireland and the Netherlands, on the contrary, which have a relatively higher degree of real and nominal wage rigidity, perform worse on unemployment.

For the third period it is seen that the relationship between wage rigidity and the change in unemployment breaks down completely. This holds for real wage rigidity as well as for the measures of nominal wage rigidity , which according to table 3 should be relevant in explaining the evolution of unemployment in this period.

Since it took until 1982 or 83 for fiscal policy to become restrictive in most countries, it seems reasonable to repeat the exercise, thereby defining the subperiods to be 1973-82, 1982-86 and 1986-89. Consider first the period 1973-82. The rank order correlations become even higher for this extended period (0.78, 0.82 and 0.75, respectively), as compared to the results for the period 1973-79. This higher correlation stems from Ireland and Finland, which appeared to be exceptions if the period was defined to be 1973-79, but which fit quite well into the assumed relationship if the period is extended to 1982.

When defining the second period to be 1982-86 it is seen that the correlations are markedly lower. This means that the high correlation for the period 1979-86 is rather a phenomenon for the

period 1979-82.

We can conclude as follows. The characteristics of wage formation can be considered as one of the factors explaining the unemployment evolution of the small countries during the 1970s until the mid of the 1980s. However, the relationship clearly breaks down in the subsequent period and especially in the years following the positive oil price shock of 1986. Since this conclusion is quite drastic and could eventually be the result of the choice of the countries, we repeated the exercise including six large industrial countries (see appendix 3) [9]. It is shown that the same conclusions apply to the complete set of both small and large industrial countries.

One might speculate about the reasons for the non-existence of a relationship between nominal wage rigidity and the change in unemployment in the post 1986 period. One possible explanation is that the period has been too short to observe the expected employment effects. It can then be argued that a longer period is needed before nominal wage flexibility gives expression to employment effects under both shocks experienced during the period.

Another possible explanation is that the change in unemployment might be affected by other forces that muddle up the correlation,

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[9] The countries included are: France, Germany, Italy, Japan, United Kingdom and the United States.

such that the effect of nominal wage flexibility remains hidden. In this context it is important to notice the different extent of structural reform of the labour market in the small countries during the 1986-89 period. Although in recent years most of the countries succeeded in improving the efficiency of their labour market (e.g. greater flexibility of rules governing working hours and overtime, simplification of administrative procedures for hiring or laying off employees, limited-duration labour contracts, higher qualification of employees, ...) they clearly did so in varying degrees [10]. This means that specific policies to increase the efficiency of the labour market and the resulting incentives for firms to hire new workers went further in some countries (e.g. the Netherlands) than in others (e.g. Norway).

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[10] See OECD (1990), supplement: Progress in structural reform.

Appendix

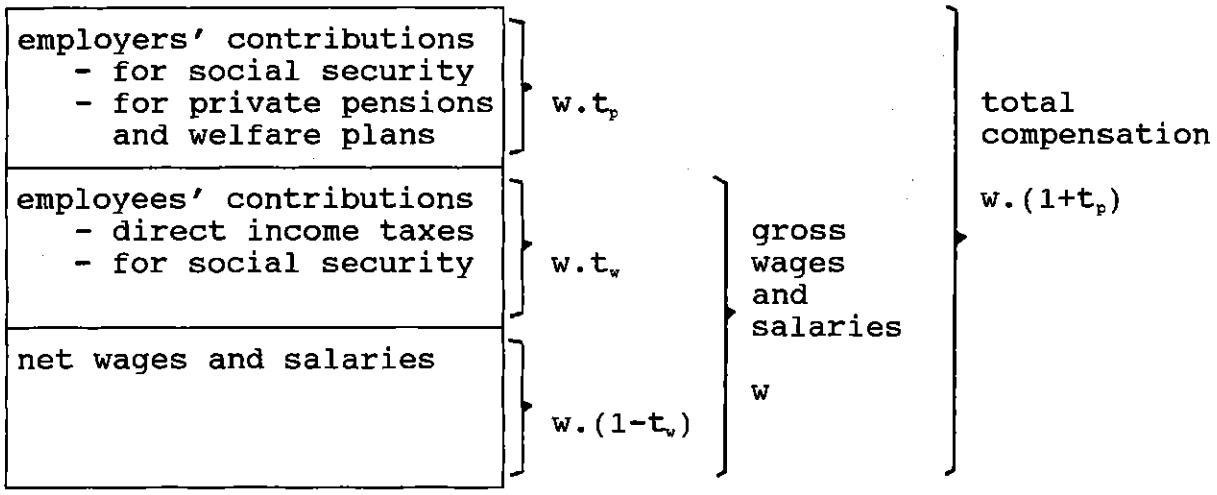
Appendix 1. Derivation of the wage equation.

In this appendix, we develop a simple wage-bargaining model in which claims and offers made by employees and employers, respectively, determine nominal wage growth. This model shows that, besides traditional determinants of nominal wages such as inflation, unemployment and productivity, which can be explained by the Phillips equation there are some additional determinants. More in particular, our theoretical framework shows that the development of wages depends on the following conditions:

- the level of the unemployment rate and the operation of the Phillips-curve mechanism, that determines the ultimate outcome of the bargaining process;
- the extend to which employees succeed in absorbing productivity growth in their earnings;
- the shifting forward by employees of higher direct taxes and contributions to social security funds;
- the rolling off by employers of higher contributions to social security and pension programs onto employees;
- the inflation rates relevant to employers and employees, represented by output and consumer prices, their divergence representing the impact of indirect taxes and terms of trade changes.

In the table below we give a schematic overview of the composition of total compensation of employees into employers' contributions, employees' contributions and net wages and

salaries.



We first derive employers' wage offers and employees' wage claims. Thereafter, the wage change proposals of both parties are confronted in a simple bargaining process.

a. Employers' wage offers.

Wage offers by employers can be derived from the first order condition for profit maximizing firms. Suppose that $\pi = p_y.Y - w.(1+t_p).L$ where π is profits, p_y is the output price level, Y is the volume of production, w is gross wages and salaries, t_p is employers' contribution rate and L is employment. The first order condition for maximizing a firm's profit is then given by:
$w = (q.p_y)/(1+t_p)$ where $q = \partial Y/\partial L$ is marginal labour productivity.

Transforming the result to percentage changes gives us:

$$\dot{w} = \dot{p}_y + \dot{q} - (1 \dot{+} t_p)$$

With a production function of the CES type we can write:

$Y = (\alpha . L^{-\mu} + (1-\alpha) . K^{-\mu})^{-1/\mu}$

and $q_{ces} = \partial Y/\partial L = \alpha . (Y/L)^{1+\mu}$

such that $\dot{q}_{ces} = (1+\mu) . (\dot{Y}-\dot{L})$

If instead the production function is Cobb Douglas we have:

$Y = \alpha_0 . L^{\alpha_1} . K^{\alpha_2}$

and $q_{cd} = \partial Y/\partial L = \alpha_1 . (Y/L)$

such that $\dot{q}_{cd} = (\dot{Y}-\dot{L})$

For simplicity, we can define labour productivity growth to be approximately the difference between production and employment growth: $\dot{q} = \dot{Y}-\dot{L}$

With a CES production function this means that $\dot{q}_{ces} = (1+\mu) . \dot{q} = (1/\sigma) . \dot{q}$ where σ is the elasticity of substitution.

$(1 \dot{+} t_p)$ can be rewritten in terms of $\dot{t}_p$ as follows:

$$1 \dot{+} t_p = \frac{d(1+t_p)}{1+t_p} = \frac{t_p}{1+t_p} . \frac{d(1+t_p)}{t_p} = \frac{t_p}{1+t_p} . \frac{dt_p}{t_p} = \frac{t_p}{1+t_p} . \dot{t}_p$$

From the above condition for maximization of profits an expression can be derived for the employers' <u>wage offers</u> in percentage changes:

$\dot{w}^{\circ} = \dot{p}_y + \dot{q}/\sigma - (t_p/(1+t_p)).\dot{t}_p$

if we consider a CES production function.

The first term of this equation shows that employers offer wage-earners not compensation for a rise in consumer prices but for a rise in GDP prices. The reason is, of course, that employers will obtain the last mentioned prices for their products. Compensation for consumer prices, which may rise faster than GDP prices because of, for example, a deterioration in the terms of trade or an increase in indirect taxes, can result in a decline in profits, being inconsistent with the chosen starting-point of profit maximizing firms. The second term shows that employers' offers also contain productivity growth. The final term points out that an increase in the employers' contribution rate ($\dot{t}_p > 0$) will have a negative impact on their offers to wage-earners. Indeed, employers try to avoid an increase in total labour costs $w.(1+t_p)$ by rolling off $\dot{t}_p$ onto their employees and so by offering them lower wages and salaries w . It is obvious, however, that the burden of employers' contributions is only a part of total labour costs so that $\dot{t}_p$ applies only to this part. With full rolling off of $\dot{t}_p$ onto employees (i.e. no change in total labour costs), a rise of t_p by 10% will not decrease w by fully 10%. Therefore, to adequately measure the negative contribution of $\dot{t}_p$ for $\dot{w}^{\circ}$, we have to multiply $\dot{t}_p$ by the factor $t_p/(1+t_p)$.

b. Employees' wage claims.

A common assumption about the objectives of wage-earners is that they are essentially concerned with their net real earnings $w.(1-t_w)/p_c$, where t_w is employees' contribution rate and p_c is the consumer price level. More specifically, we can assume that they aim at an increase of their real wages which is in line with productivity growth. This assumption is consistent with neo-classical growth theory. Expressed in percentage changes, we have:

$$\dot{w} = \dot{p}_c + \dot{q} - (\dot{1-t_w})$$

Again $(\dot{1-t_w})$ can be reformulated in terms of $\dot{t}_w$ as follows:

$$\dot{1-t_w} = \frac{d(1-t_w)}{1-t_w} = \frac{t_w}{1-t_w} \cdot \frac{d(1-t_w)}{t_w} = -\frac{t_w}{1-t_w} \cdot \frac{d\,t_w}{t_w} = -\frac{t_w}{1-t_w} \cdot \dot{t}_w$$

Employees' being concerned with the growth of net real earnings, we can derive the following equation expressing employees' <u>wage claims</u> in percentage changes:

$$\dot{w}^c = \dot{p}_c + \dot{q} + (t_w/(1-t_w)).\dot{t}_w$$

The first two terms of the equation show that wage earners claim full compensation for higher consumer prices and labour productivity. In other words, employees seek to increase their real wages in line with productivity growth, which is consistent with neo-classical growth theory.

The final term stands for the burden of direct taxes and employees' social security contributions. Employees will try to shift forward an increase in this burden into higher wages and salaries w, which means that they do not bargain for wages as such, but for net real wages. The employees' burden rate t_w applies only to the fraction of direct taxes and social security contributions in their net wages and salaries. We therefore multiply $\dot{t}_w$ by $t_w/(1-t_w)$ to measure its contribution for $\dot{w}^c$.

c. Confrontation of wage change proposals.

In the bargaining process the proposals of the parties are confronted. Assuming that negotiations are about wage changes, we can describe the growth of nominal wages and salaries as a weighted average of wage claims and wage offers, the weights representing the bargaining strength off the respective parties:

$$\dot{w} = \lambda.\dot{w}^o + (1-\lambda).\dot{w}^c \quad \text{with} \quad 0 \leqslant \lambda \leqslant 1$$

We further assume that the bargaining power depends on the labour market situation, characterized by the rate of unemployment. Bargaining strength may then be represented by the weighting function:

$$\lambda = \lambda(u) \quad \text{with} \quad 0 \leqslant \lambda \leqslant 1 \quad \text{and} \quad \partial\lambda/\partial u > 0$$

If unemployment decreases and labour markets are tight, then λ will decrease and wage claims will become more important, and vice versa. In this sense, it is the operation of the Phillips-curve mechanism that is giving wage claims and wage offers the appropriate weights, and that determines the ultimate outcome of the bargaining process.

We now linearize the above equation around the triplet $x_o = \begin{pmatrix} \lambda_o \\ \dot{w}^c_o \\ \dot{w}^o_o \end{pmatrix}$

Let $h(x) = \lambda . \dot{w}^o + (1-\lambda).\dot{w}^c$

such that $h(x) = h(x_o) + \left.\frac{\partial h}{\partial x}\right|_{x=x_o} . (x-x_o)$

$$\left.\frac{\partial h}{\partial \lambda}\right|_{x=x_o} = \dot{w}^o_o - \dot{w}^c_o$$

$$\left.\frac{\partial h}{\partial \dot{w}^c}\right|_{x=x_o} = 1-\lambda_o \qquad \left.\frac{\partial h}{\partial \dot{w}^o}\right|_{x=x_o} = \lambda_o$$

and $h(x) = \lambda_o . \dot{w}^o_o + (1-\lambda_o).\dot{w}^c_o + (\dot{w}^o_o - \dot{w}^c_o).(\lambda-\lambda_o)$
$+ (1-\lambda_o).(\dot{w}^c - \dot{w}^c_o) + \lambda_o . (\dot{w}^o - \dot{w}^o_o)$

or $h(x) = (1-\lambda_o).\dot{w}^c + \lambda_o.\dot{w}^o + (\dot{w}^o_o - \dot{w}^c_o).(\lambda-\lambda_o)$

This means that:

$\dot{w} = -\lambda_o.(\dot{w}^o_o - \dot{w}^c_o) + (\dot{w}^o_o - \dot{w}^c_o).\lambda + \lambda_o.\dot{w}^o$
$+ (1-\lambda_o).\dot{w}^c$

If we assume that $\lambda = \delta.u$, with $\delta > 0$ a measure of the dependence of the bargaining power parameter on the unemployment rate, and repeat that

$\dot{w}^o = \dot{p}_y + \dot{q}/\delta - (t_p/(1+t_p)).\dot{t}_p$

$\dot{w}^c = \dot{p}_c + \dot{q} + (t_w/(1-t_w)).\dot{t}_w$

Substitution will give the fully specified equation for nominal wage growth:

$$\dot{w} = \alpha_1 + \dot{p}_c + \alpha_3.\dot{q} + \alpha_4.(\dot{p}_y - \dot{p}_c) + \alpha_5.u$$
$$\alpha_6.(t_p/(1+t_p)).\dot{t}_p + \alpha_7.(t_w/(1-t_w)).\dot{t}_w$$

with $\alpha_1 = -\lambda_0.(\dot{w}^o_0 - \dot{w}^c_0)$ $\qquad$ $\alpha_4 = \lambda_0$

$\alpha_2 = 1$ $\qquad$ $\alpha_5 = \delta.(\dot{w}^o_0 - \dot{w}^c_0)$

$\alpha_3 = \lambda_0.\frac{1}{\delta} + (1-\lambda_0)$ $\qquad$ $\alpha_6 = -\lambda_0$

$\alpha_7 = 1-\lambda_0$

Notice the interdependence between the coefficients. Both $\dot{p}_c$ and $(t_w/(1-t_w)).\dot{t}_w$ have the same coefficient $1-\lambda_0$, and $\dot{p}_y$ and $(t_p/(1+t_p)).\dot{t}_p$ have the same coefficient λ_0. This results from the fact that the bargaining model is symmetrical in nature, with the weights on $\dot{w}^o$ and $\dot{w}^c$ adding up to unity.

Recognizing the complex structure of wage formation within a bargaining framework, we can more generally write that:

$\dot{w} = f(\dot{w}^o, \dot{w}^c, u)$

The coefficients are no longer necessarily interdependent. If we moreover assume a dynamic adjustment process of wages over time such that in the long run wages fully respond to price changes (this means that the coefficient on $\dot{p}_c$ is a priori contrained to be 1), the nominal wage equation can be written as:

$$\dot{w} = a_0 + \gamma.(\dot{p}_c + a_1.(\dot{p}_y - \dot{p}_c)) + a_2.u + a_3.\dot{q}$$
$$+ a_4.(t_w/(1-t_w)).\dot{t}_w + a_5.(t_p/(1+t_p)).\dot{t}_p + (1-\gamma).\dot{w}_{-1}$$

where γ is the adjustment coefficient that determines whether nominal wages adapt quickly to prices or not.

Appendix 2. Estimation results for the wage equation (eleven small and six large industrial economies).

The tables below give the results from estimating the nominal wage equation derived in appendix 1 for the eleven small and six large industrial economies, using OLS and yearly data covering the beginning of the 1960s to the end of the 1980s.

Table A0a. Wage formation in eleven small open economies.

	a_0	γ	a_1	a_2	a_3	a_4	a_5	$\bar{R}^2$	SER	F	Notes :
Australia (1962-88)	4.03 (3.10)	0.95 (6.21)	0.23 (0.95)	-0.61 (3.37)	0.32 (1.15)	----	----	0.81	2.22	22.96	(1) no AR(1) (2) dummy 1974=1 8.57 (3.36)
Austria (1967-87)	2.20 (1.34)	0.62 (4.22)	0.85 (2.00)	-0.67 (1.71)	0.59 (3.02)	-0.06 (0.36)	-1.91 (1.78)	0.89	1.38	23.51	(1) corrected for AR(1) r -0.48 (1.94) (2) $\dot{q}_{-1}$ instead of $\dot{q}$
Belgium (1963-87)	5.72 (3.63)	1.01 (6.79)	0.58 (1.88)	-0.48 (3.22)	0.42 (2.60)	-0.17 (1.36)	-0.79 (1.28)	0.92	1.27	38.33	(1) corrected for AR(1) r 0.49 (1.93)
Denmark (1962-87)	4.39 (5.15)	1.04 (7.45)	0.91 (5.14)	-0.40 (3.94)	0.23 (1.27)	----	----	0.74	1.50	18.65	(1) no AR(1)
Finland (1962-87)	6.66 (5.51)	1.05 (8.48)	0.18 (1.00)	-1.11 (5.37)	0.59 (2.97)	0.04 (0.50)	-1.08 (1.42)	0.86	1.69	26.81	(1) no AR(1)
Ireland (1962-87)	6.07 (3.32)	1.28 (8.02)	0.28 (2.90)	-0.32 (2.91)	0.39 (1.62)	----	----	0.86	2.22	39.17	(1) no AR(1) (2) $\dot{q}_{-1}$ instead of $\dot{q}$
Netherlands (1962-88)	4.09 (2.48)	0.97 (5.01)	1.33 (2.70)	-0.27 (1.78)	0.22 (0.91)	----	----	0.70	2.60	12.77	(1) no AR(1) (2) dummy 1974=1 5.70 (2.04)
New Zealand (1963-86)	2.77 (2.25)	0.82 (4.02)	0.58 (1.73)	-0.84 (1.85)	0.30 (0.75)	----	----	0.60	3.49	9.65	(1) no AR(1)
Norway (1964-88)	3.82 (2.39)	0.74 (4.76)	-0.12 (0.41)	-1.81 (2.67)	0.50 (1.78)	----	----	0.46	2.22	5.82	(1) no AR(1)
Sweden (1962-87)	1.91 (1.35)	0.57 (6.42)	1.35 (4.08)	-1.37 (2.20)	0.70 (5.05)	0.01 (0.22)	-0.08 (0.29)	0.60	1.22	7.36	(1) no AR(1)
Switzerland (1966-87)	1.42 (4.03)	1.04 (8.93)	0.75 (5.54)	-1.05 (2.35)	0.61 (5.82)	0.26 (1.88)	-1.10 (1.25)	0.93	0.84	38.03	(1) corrected for AR(1) r -0.48 2.02 (2) dummy 1971=1 3.71 (3.33)

Table A0b. Wage formation in six large open economies.

	a_0	γ	a_1	a_2	a_3	a_4	a_5	$\bar{R}^2$	SER	F	Notes :
France (1965-88)	4.40 (1.94)	0.93 (6.67)	0.58 (2.25)	-0.43 (2.68)	0.37 (1.05)	----	----	0.95	1.00	82.12	(1) no AR(1) (2) dummy 1974&75=1 2.65 (2.33)
Germany (1962-87)	3.58 (3.80)	0.96 (8.62)	1.08 (6.06)	-0.46 (4.11)	0.35 (2.85)	0.13 (1.76)	-0.84 (1.56)	0.94	0.85	50.92	(1) no AR(1) (2) dummy 1970=1 3.52 (3.04) (3) Δu also included -0.69 (2.21)
Italy (1962-88)	6.10 (2.14)	0.96 (5.48)	1.96 (3.25)	-0.60 (2.36)	0.65 (2.89)	----	----	0.78	2.56	25.41	(1) no AR(1)
Japan (1967-87)	6.67 (1.65)	0.56 (4.41)	0.93 (1.28)	-2.42 (1.74)	0.31 (1.42)	0.11 (0.20)	-1.65 (0.99)	0.94	1.74	56.55	(1) nor AR(1)
Un. Kingdom (1963-86)	2.36 (1.44)	1.03 (9.43)	1.34 (4.60)	-0.23 (1.03)	0.43 (2.07)	0.28 (1.01)	-1.38 (1.23)	0.91	1.74	34.15	(1) corrected AR(1) r 0.59 (1.98)
Un. States (1963-87)	1.92 (8.52)	0.64 (13.21)	0.89 (5.56)	-0.27 (9.61)	0.51 (12.82)	0.13 (4.05)	-0.88 (4.79)	0.95	0.35	66.36	(1) corrected AR(1) r -0.80 (5.86)

Definitions and sources of data:

t_w is defined as the sum of total taxes on employees' income and employees' contributions to social security schemes devided by gross nominal wages. t_p is calculated as employers' contributions to social security and private pension schemes as a proportion of gross nominal wages. Gross nominal wages w are equal to employees' total compensations minus employers' contributions. All the series were taken from OECD, National Accounts, Detailed tables -table 8.

$\dot{q}$ is computed by subtracting the growth rate of employment from the growth rate of GNP or GDP at constant prices. GDP or GDP is taken from IMF, International Financial Statistics. Employment is taken from OECD, Economic Outlook.

The source of $\dot{p}_c$ and $\dot{p}_y$ is IMF, International Financial Statistics.

u is taken from OECD, Economic Outlook.

Appendix 3. Extension of the analysis, including six large industrial economies.

Table A1. Evolution of unemployment in six large industrial countries (as a % of the labour force).

country	1979/1973	1986/1979	1989/1986
France	+3.3	+4.4	-0.9
Germany	+2.3	+3.5	-0.9
Italy	+1.4	+3.4	+1.0
Japan	+0.8	+0.7	-0.5
Un.Kingdom	+2.4	+7.3	-5.6
Un.States	+0.9	+1.2	-1.7
Average (unweighted)	+1.9	+3.4	-1.4

Source: OECD, Economic Outlook 47, June 1990, table R19.

Table A2a. Average short-term and long-term interest rates (real, delated by CPI).

Money market interest rates.

country	1974-79	1980-86	1987-89
France	-1.49	2.88	5.02
Germany	0.47	3.55	3.34
Italy	-3.31	3.36	6.53
Japan	-2.40	3.85	2.75
Un.Kingdom	-10.94	2.95	5.68
Un.States	-0.88	4.75	3.66
Average	-3.09	3.56	4.50

Government bond yield.

country	1974-79	1980-86	1987-89
France	-1.20	3.75	5.93
Germany	3.07	4.50	4.91
Italy	-3.54	2.33	4.88
Japan	-2.04	4.19	3.16
Un.Kingdom	-2.09	3.69	3.87
Un.States	-0.48	5.33	4.41
Average	-1.05	3.97	4.53

Source: IMF, International Financial Statistics, Yearbook 1989 and June 1990 (lines 60b, 61 and 64).

Table A2b. Cyclically-adjusted budget balances based on a trend output benchmark (changes as a per cent of trend GNP/GDP; period averages).

country	1974-82	1983-86	1987-89
France	-0.08	+0.20 (+0.37)	-0.20 (+0.26)
Germany	+0.09	+0.40 (+0.52)	+0.10 (+0.10)
Italy	-0.41	-0.03 (+0.08)	+0.13 (+0.13)
Japan	-0.34	+0.63 (+1.11)	+0.70 (+0.69)
Un.Kingdom	+0.66	-0.50 (-0.27)	+0.60 (+0.82)
Un.States	+0.18	-0.60 (-0.34)	+0.17 (+0.36)
Average	+0.10	+0.02 (+0.25)	+0.25 (+0.39)

Source: Price, R.W. & Muller, P. (1984), table 6, and OECD, Economic Outlook, various issues. The figures between brackets are taken from a more recent study: Chouraqui, J.-C., Hagemann, R.P. & Sartor, N. (1990), table 4.

Table A4. Parameters of the nominal wage equation and measures of wage rigidity.

country	γ	a_1	a_2	a_3	a_4	a_5
France	0.93	0.58	-0.43	(0.37)	-	-
Germany	0.96	1.08	-0.46	0.35	0.13	(-0.84)
Italy	0.96	1.96	-0.60	0.65	-	-
Japan	0.56	(0.93)	-2.42	(0.31)	(0.11)	(-1.65)
Un.Kingdom	1.03	1.34	(-0.23)	0.43	(0.28)	(-1.38)
Un.States	0.64	0.89	-0.27	0.51	0.13	-0.88

Figures are put between brackets if the estimated coefficient is statistically not significantly different from zero.

	real wage rigidity			nominal wage rigidity		
country	RWR1	RWR2	RWR3	NWR1	NWR2	NWR3
France	2.16	2.16	0.92	0.74	0.74	0.52
Germany	2.09	1.19	0.51	0.70	0.56	0.35
Italy	1.60	0.77	0.30	0.64	0.45	0.24
Japan	0.23	0.23	0.23	0.34	0.34	0.34
Un.Kingdom	oo	2.40	0.58	0.97	0.68	0.36
Un.States	2.37	0.82	0.38	1.10	0.70	0.43
Average	2.16	0.95	0.42	0.72	0.53	0.34

Table A5. Spearman rank correlation coefficients between the various measures of real and nominal wage rigidity.
(eleven small and six large industrial economies)

RWR2	RWR3	NWR1	NWR2	NWR3	
0.90	0.61	0.74	-	-	RWR1
-	0.77	-	0.85	-	RWR2
-	-	-	-	0.80	RWR3
-	-	-	0.85	0.46	NWR1
-	-	-	-	0.72	NWR2

The critical values for the Spearman rank order correlation coefficient are 0.414 and 0.566 at the 5% and 1% level, respectively.

Table A6. Spearman rank correlation coefficients between the measures of wage rigidity and the change in unemployment.
(eleven small and six large industrial economies)

	1973-79	1979-86	1986-89
RWR1	0.51	0.79	-0.48
RWR2	0.69	0.78	-0.36
RWR3	0.77	0.50	-0.39
NWR1	0.33	0.61	-0.38
NWR2	0.55	0.63	-0.29
NWR3	0.61	0.44	-0.24

	1973-82	1982-86
RWR1	0.84	0.33
RWR2	0.86	0.36
RWR3	0.74	0.29
NWR1	0.64	0.09
NWR2	0.73	0.16
NWR3	0.67	0.11

The critical values for the Spearman rank order correlation coefficient are 0.414 and 0.566 at the 5% and 1% level, respectively.

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