The Impact of Central Bank Independence and Union Concentration on Macroeconomic Performance in the Presence of Aggregate Supply Shocks

Evidence from 10 OECD Countries (1971-85)

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Abstract

In this paper, we use panel data from 1971 to 1985 to test the hypothesis that differences in monetary and wage institutions can explain a significant fraction of the variations in the macroeconomic performance of 10 OECD countries following the OPEC shocks of 1973-74 and 1979-80. After controlling for central bank independence, we detect a hump-shaped relationship between union density and inflation, and a negative relationship between union concentration and inflation. These findings are robust to the use of different estimators and across various assumptions on the structure of error terms. The impact of central bank independence and union variables on unemployment is more ambiguous, and is sensitive to the inclusion of interactions between these variables. Interesting results are obtained when we split out sample, first by the degree of central bank independence, and then by union concentration.

Keywords : Collective bargaining, central bank independence, inflation, unemployment

JEL Classification: E24, E31, E58, J51

I. Introduction

In this paper, we aim to find the keys that may help us to unlock the following puzzle: why did the inflation and unemployment experiences of advanced Western European economies vary so dramatically following the twin oil shocks of 1973-74 and 1979-80? Why did Sweden maintain an unemployment rate of 2% between 1971 and 1985, while the Netherlands saw its unemployment rate soar from 2% to 13% over the same period? Why was Germany's average inflation rate under 5% while Italy's averaged 14% in the same decade and a half? We believe that the answer to these questions lie in the monetary and labor market institutions found in these countries. Inflation results from coordination failures in wage contracting when rational, optimizing unions participating in unsynchronized and decentralized wage bargaining with firms engage in nominal wage push to prevent erosion of their relative and real wages. If this push is accommodated by the monetary authority, then wage and price inflation results. If it is not, the increase in real wages raises unemployment.

Previous papers have shown that differences in the organization of worker and employer unions (such as the degree of centralization or "corporatism") explain a considerable part of the diverse inflationary experiences among otherwise similar economies, even after accounting for differences in the independence of their central banks. For example, Calmfors and Driffill (1988) report the existence of a hump-shaped relationship between the degree of centralization in wage bargaining and real wages, inflation and unemployment. The idea is that competitive forces restrain wages, while potential gains from internalization of the external effects of wage increases are greater within large encompassing organizations. Intermediate degrees of centralization are harmful in that organized interests may be most detrimental to social welfare when they are strong enough to

cause significant disruptions but insufficiently encompassing to bear sufficiently the costs inflicted upon society by their self-interested actions.

More specifically, when wage bargaining is centralized, the parties involved tend to internalize the impact of their wage push on price inflation and recognize its futility in raising the real wage. On the other hand, decentralized wage bargaining makes individual firms more resistant to rising wage demands as each firm faces an elastic demand curve and competitors who may not be under the same cost pressure. Intermediate levels of wage bargaining result in the worst inflation and unemployment performance because neither of these "externality" and "competition" effects is present to induce wage restraint. Further support for the hump-shaped hypothesis may be found in Dowrick (1993), Freeman (1988), Heitger (1987), and Rowthorn (1992).

Other papers in the literature have tested for the presence of a *linear* relationship between a country's economic performance and its degree of corporatism. For example, Bruno and Sachs (1985) study the relationship between corporatism (defined as the 'institutionalized negotiation, bargaining, collaboration, and accord about wages and 'income policies' between representatives of the major economic groupings, most typically labor confederations and employers' associations') and macroeconomic outcomes such as the misery index. Using an index of labor market corporatism (taking into consideration union movement centralization, shop-floor autonomy, and employer coordination), the authors find that each unit rise in the index is associated, for given GDP performance, with a reduction in inflation of 1.5 percentage points.

The literature on monetary institutions and inflation, on the other hand, has largely arisen out of the time inconsistency models of Kydland and Prescott (1977) and Barro and Gordon (1983). In these models, the lack of credible commitment devices leads central banks to choose higher than optimal rates of inflation, even though they share the private sector's preferences for inflation

relative to output. These models suggest that institutional features of a central bank (such as the length of it's governor's term of appointment) may significantly affect inflation outcomes. In addition, Rogoff (1985) has argued that governments have an incentive to appoint 'conservative' central banks (that is, those who have an anti-inflation reputation) so as to raise their anti-inflation credibility. The degree of influence of the central bank on monetary policy (its 'independence') should therefore be reflected in the country's inflation figures. Such a relationship has been verified empirically by Grilli, Masciandaro and Tabellini (1991), Alesina and Summers (1993), and Cukierman, Webb and Neyapti (1992), among others.

One of the earliest attempts to combine the above two strands of research is Bleaney (1996), who finds, in his sample of 17 OECD countries, that central bank independence has a significant effect on CPI inflation while the labor market variables (the Bruno-Sachs corporatism index, the Calmfors-Driffill centralization ranking, and a composite index of the two) are mostly insignificant. With regards to unemployment, Bleaney finds that greater centralization and stronger corporatism exert a salubrious influence.

On the theoretical side, two recent papers model the interaction of labor unions and the monetary authority in the framework of a non-cooperative game but produce contrasting predictions of the role of centralization and central bank independence in explaining inflation and unemployment. In Cukierman and Lippi (1999), the labor market is characterized by the degree of centralization of bargaining and by the degree of trade unions' inflation aversion. The latter leads each union to moderate its wage demands in order to induce the central bank to inflate at a lower rate. As in the Calmfors and Driffill paper, increasing centralization produces two opposing effects on real wages and inflation: the decrease in the number of unions reduces the substitutability between the labors of different unions and the degree of effective competition between them (the

"competition effect") while strengthening the moderating effect of inflationary fears on the real wage demands of each union (the "strategic effect"). The interaction between these two effects determines the shape and position of the relation between centralization, real wages, inflation and unemployment. For example, there is a hump-shaped relationship between centralization and inflation for countries with low CBI and a positive monotonic relationship for countries with high CBI. Velasco and Guzzo (1999) build a general equilibrium, optimizing model from microeconomic foundations to study the joint effects of centralization in wage setting and central bank independence. In contrast to conventional wisdom, the model implies that a radical-populist banker who disregards inflation maximizes social welfare, while economic performance is *not* U-shaped in the degree of centralization.

In this paper, we construct an alternative measure of coordination in wage bargaining - a Herfindahl index of concentration among union confederations - for 10 OECD countries, based on 1971-1985 union panel data compiled by Visser (1989). This index, together with union density and central bank independence, are used as explanatory variables in inflation and unemployment regressions utilizing several alternative estimators.[1]

Our results suggest that, even after controlling for central bank independence, union density and union concentration are significantly correlated with price inflation across countries. We find that there is a hump-shaped relationship between union density and inflation, and a negative relationship between union concentration and inflation. Many of these results are robust to the use of different estimators and assumptions on the error structure of the regression. The results from the unemployment regressions are less clear-cut and are highly sensitive to the inclusion of interactions between central bank independence and labor market variables. They suggest that greater central

[1] Previous empirical studies have used only cross-sectional data and simple econometric techniques (relying primarily on OLS estimation).

bank independence and union concentration probably raise unemployment, while union density and unemployment exhibit a non-linear relationship. When we divide countries into groups by their union concentration measures, we observe that central bank independence and union density affect inflation and unemployment quite differently among the three groups. Similarly, we find that the impact of union concentration on inflation and unemployment varies when we stratify our sample by central bank independence.

The paper is organized as follows: Section II discusses our data sources and methodology. Section III describes our empirical specifications, and is followed by a presentation of our results in section IV. In Section V, we show the corresponding results when unemployment is the dependent variable. Section VI investigates how differently union variables impact inflation and unemployment for countries with low central bank independence vis-à-vis those with high central bank independence; section VII concludes.

II. Data Sources and Methodology

The measure of central bank independence used in our regressions is the overall decade-average measure by Cukierman, Webb and Neyapti (1992). This is an index of legal independence based on 16 different criteria covering the following areas: the terms of office, appointment and dismissal of the central bank governor; determination of monetary policy; the objectives of the central bank; and the limitations on the ability of the central bank to lend to the government. The chief drawback of this index (and others such as Grilli, Masciandaro, and Tabellini (1991)) is that CBI is assumed to be time-invariant, when in fact regime shifts are plausible and indeed do occur, albeit infrequently.

The labor market variables used in our empirical work are union density (the percentage of the workforce that is unionized) and a measure of the concentration of unions. The computation of

the latter variable requires year-by-year membership figures for every union confederation in each included country. In this paper, we rely on the figures for 10 OECD countries compiled by Visser (1989), who took particular care to ensure that the data for the different countries are as comparable as possible. Visser used sources published by national statistical offices, union confederations, trade union research centers, in statistical yearbooks, monographs, trade union yearbooks, journals and surveys for the compilation of his statistics.

Our measure of union concentration in each country is a Herfindahl index of the membership shares of each union confederation in that country. Specifically,

$$H_{it} = \sum_j \left(\frac{m_{ijt}}{m_{it}} \right)^2$$

where i denotes a country and t denotes a year. m_{ijt} is the membership figure for the jth union confederation in country i in year t, while m_{it} is the total union membership for country i in year t. The index attains its maximum value when there is one union confederation accounting for the entire union membership in a country. For a given number of union confederations, the index is smallest when these confederations are of identical size.[2]

The theoretical motivation for using this Herfindahl index of union concentration is our belief that nominal wage push is generated by unions who do not internalize the costs that their demands for higher nominal wages impose on the economy. The lack of coordination and the resulting wage inflation (which feeds into price inflation if firms practice mark-up pricing) is more severe in countries where union confederations are numerous, weak and fragmented. Although

[2] Alternatively, we can combine the measures of union density and union concentration into a single index: $H_{it} = \sum_j \left(\frac{m_{ijt}}{L_{it}} \right)^2$ where L_{it} is the total labor force for country i in year t and every non-unionized worker is treated as an independent union with a membership of one. However, we believe that union density and union concentration exert independent effects on our nominal and real variables of interest, and that it is important to distinguish between these effects.

wage bargaining in some countries may take place at the industry or firm level rather than at the national level, industry-level and firm-level unions operate largely under the direction of their national union confederations, which set wage norms and determine the unions' posture at the bargaining table. Union density also plays a part in determining wage inflation: fragmented unions are more successful in their wage push if the labor force is more highly unionized (so that the elasticity of demand for a union's labor is lower).

Conceptually, our measure of union concentration is similar to the Calmfors and Driffill's centralization rankings and Bruno-Sachs' corporatism index. Bruno and Sachs use an index of 'corporatism' which arranges countries on a scale of 0 to 4. Corporatism is taken to mean 'institutionalized negotiation, bargaining, collaboration and accord about wages…between representatives of the major economic groupings in the society'. The corporatism index is made up of a subjective one/zero categorization along four dimensions: national rather than plant-level wage negotiations, power of trade unions *vis-à-vis* their members; degree of employer organization; and weakness of shopfloor union representatives.

Calmfors and Driffill (1988) argue that both highly centralized and highly decentralized wage-bargaining systems are better than moderately centralized systems, which tend to create an incentive for leapfrogging behavior between well-organized bargaining groups. Translating the concept of centralization into a number for each country is complicated, however. The authors offer only a ranking of countries by degree of centralization based on *subjective* judgement on the levels of coordination within national union confederations and national employer organizations, as well as the number of existing central union confederations (and employer federations) and the extent of their cooperation.

The advantage of using union concentration over the Calmfors-Driffill and Bruno-Sachs measures is its objectivity, being mathematically computed from raw data on union confederation membership. Moreover, union confederation membership figures fluctuate from one year to another, and new union confederations are occasionally created while some others are dissolved, thereby making the use of panel data possible. The drawback to the union concentration measure, however, is that it does not take into consideration the actual level (plant, industry, or national) where wage bargaining takes place, and may be missing qualitative information captured by the other indices. For example, our measure has particular difficulties with the UK. The UK appears to have high union concentration since there is only one national union confederation (the Trade Union Congress), although in reality the wage negotiations take place at the plant level, and are largely informal, fragmented, and autonomous. Wage push is thus a significant problem in the UK, although it would not appear to be so just by looking at its degree of union concentration. This problem is addressed by including dummy variables for national-level and firm-level wage bargaining.[3]

The data in our panel spans the years 1971 to 1985, encompassing the two OPEC shocks, which produced strikingly different inflationary and unemployment responses between the 10 OECD countries in our sample. They are thus advantageous in highlighting any potential repercussions of labor market and wage bargaining structures on macroeconomic performance.

In our sample of 10 OECD countries, the correlation coefficient between our union concentration measure and the Bruno-Sachs corporatism index is 0.227 (0.462 with the UK excluded), while the correlation coefficient between our measure and the Calmfors-Driffill

[3] The national-level wage bargaining dummy takes on a value of "1" for the Scandinavian countries in the sample: Denmark, Norway, and Sweden. The firm-level dummy is zero for all countries except Switzerland and the UK.

centralization ranking is 0.463 (0.634, UK excluded). The rankings of the ten countries according to each of the three indices are given in Table 1.

TABLE 1
Centralization, Corporatism and Union Concentration Rankings for 10 OECD countries, 1971-85.

Index *Ranking*	Union Concentration	Centralization (Calmfors-Driffill)	Corporatism (Bruno-Sachs)
1	Austria	Austria	Austria
2	(UK)	Norway	Germany
3	Germany	Sweden	Netherlands
4	Denmark	Denmark	Norway
5	Norway	Germany	Sweden
6	Sweden	Netherlands	Denmark
7	Italy	France	Switzerland
8	Netherlands	UK	Italy
9	Switzerland	Italy	UK
10	France	Switzerland	France

The sample statistics for our panel of 10 countries with data spanning 1971 and 1985 are shown in Table 2. (The statistics for each country are displayed in plots at the end of the paper.) The mean for the measure of central bank independence was 0.409 with a standard deviation of 0.181. The mean union density across countries and time was 0.5048 with an overall standard deviation of 0.1927. The mean union concentration (the Herfindahl index) was 0.539 with a standard deviation of 0.219. Finally, the average inflation rate (again across countries and time) was 8.65 percent with a standard deviation of 4.22 percent. The third column in the table shows the decomposition of the standard deviation of each variable into its time-series and cross-section components. We can see that the cross-country variations in CBI, union density and union concentration dominate the across-time variations in our sample.

TABLE 2
Sample statistics for 10 OECD countries, 1971-85.

Number of observations=149 (*including* UK)

Statistic *Variable*	Mean	Std. Dev.[4] Overall	[Across time, Across countries]	Min.	Max.
Central bank independence (CBI)	0.409	0.181	[0, 0.190]	0.170	0.690
Union density	50.48	19.27	[3.30, 20.04]	14.50	91.60
Herfindahl index of union concentration	0.541	0.222	[0.024, 0.233]	0.220	1.000
Consumer price Inflation (%)	8.65	4.22	[3.10, 3.46]	2.20	24.30

Statistic *Country*	CBI	Average union density	Average union concentration	Average CPI inflation (%)
Austria	0.61	0.59	1.00	5.81
Denmark	0.50	0.65	0.55	9.24
France	0.24	0.19	0.26	9.66
Germany	0.69	0.40	0.68	4.68
Italy	0.25	0.49	0.40	14.06
Netherlands	0.42	0.36	0.35	6.27
Norway	0.17	0.61	0.53	8.63
Sweden	0.29	0.80	0.48	9.17
Switzerland	0.64	0.32	0.34	7.17
UK	0.27	0.50	0.82	11.61

Sources: OECD Handbook (various issues); Cukierman, Webb, and Neyapti (1992); Visser (1989)

The simple, partial relationships between inflation and union density, inflation and union concentration, as well as between union density and union concentration, are shown in Table 3 and are plotted in Figures 1a, 1b, and 1c respectively. These figures indicate a strong positive

[4] The purpose of the classification is to distinguish between the (simple) average over time of the standard deviation across countries in each year from the (simple) average across countries of the standard deviation over time for each country. As we can see, most of the variations in the data come from the cross section rather than the time series component of the panel.

relationship between union density and union concentration (meaning that countries with low rates of unionization have fragmented union confederations), a weak negative relationship between union concentration and inflation (as predicted by our theory), and a relatively poor fit in the union density versus inflation plot.[5]

TABLE 3
Correlation coefficients between variables for 10 OECD countries, 1971-85.

Variable	CBI	Union density	Union concen-tration	CPI inflation
Central bank independence	1.000 (0.0)	-0.140 (0.089)	0.324 (.0001)	-0.467 (.0001)
Union density	-0.140 (0.089)	1.000 (0.0)	0.354 (.0001)	0.137 (0.095)
Herfindahl index of union concentration	0.324 (.0001)	0.354 (.0001)	1.000 (0.0)	-0,149 (0.069)
Consumer price inflation (%)	-0.467 (.0001)	0.137 (0.095)	-0.149 (0.069)	1.000 (0.0)

In parenthesis: Prob > |*R*|under H_0: *Rho*=0

[5] An example of an earlier study using union density as an explanatory variable for macroeconomic performance is Freeman (1988). In his paper, Freeman examines the effects of union density and wage dispersion on the rates of employment and unemployment. He findings suggest that, once wage dispersion and output are controlled for, union density does not play a significant additional role in explaining employment and unemployment. However, he does not study the effects of union density and wage dispersion on wage and price inflation.

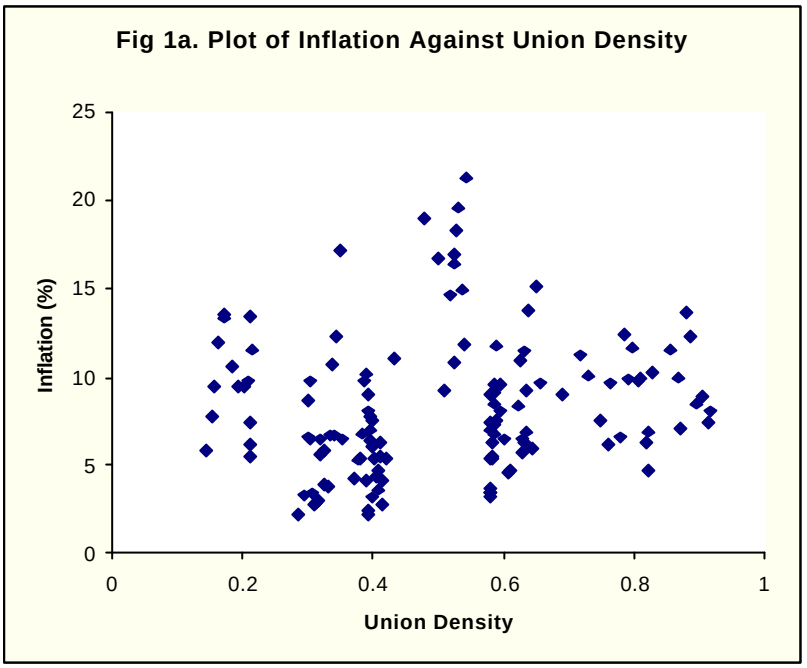


Fig 1a. Plot of Inflation Against Union Density
Inflation (%)
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
Union Density

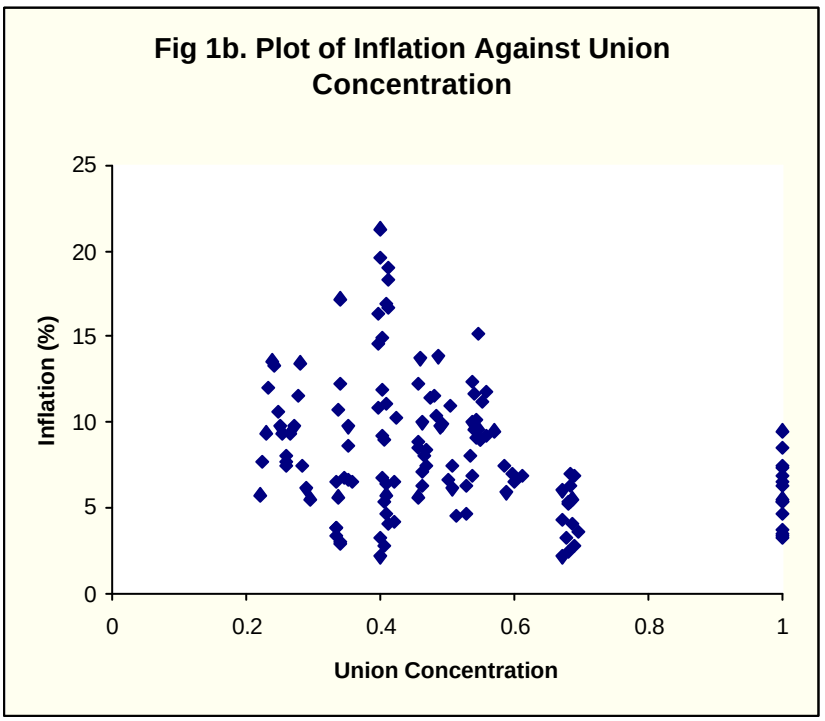
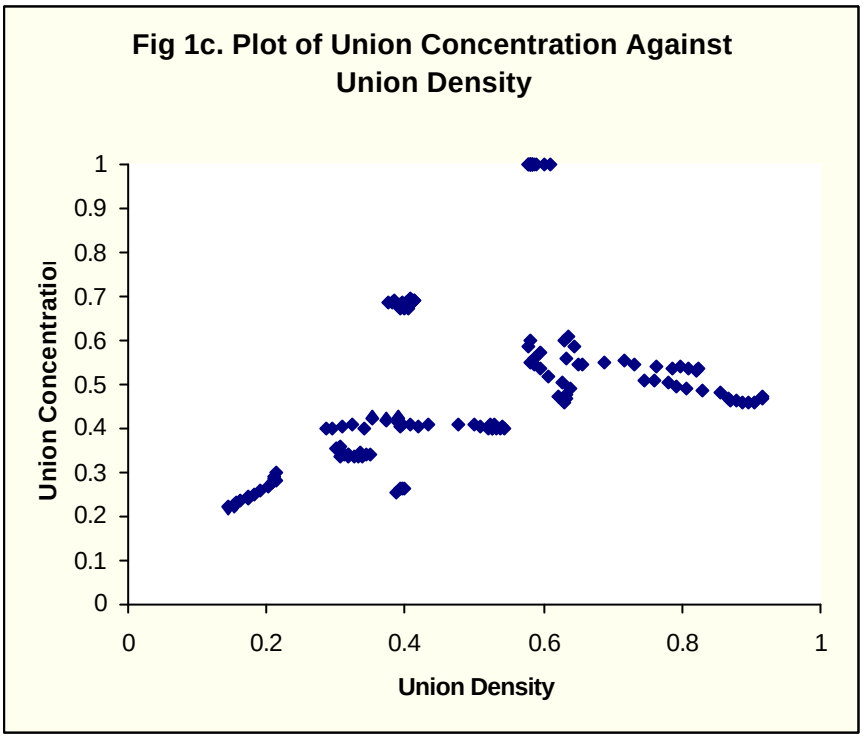


Fig 1b. Plot of Inflation Against Union Concentration
Inflation (%)
25
20
15
10
5
0
0
0.2
0.4
0.6
0.8
1
Union Concentration



III. Model Specifications

In using panel data, we are able to explore how cross-country differences and time series variations in central bank independence and union variables affect inflation and unemployment. To investigate how pure cross-country differences impact inflation, we can regress the average inflation rate for each country on their CBI index, and their average union density and concentration values. This is the "between regression":

$$\overline{INFLATION}_i = a + b_1 * CBI_i + b_2 * \overline{UDENS}_i + b_3 * \overline{UDEN2}_i + b_4 * \overline{UCONC}_i + e_i$$

where $\overline{INFLATION}_i$ is the average inflation rate for country *i*, $\overline{UDENS}_i$ is the average union density for country *i*, and $\overline{UCONC}_i$ is the average union concentration for that country.

In addition, we can remove time-invariant country-specific effects by using a fixed effects estimator. These idiosyncratic, country-specific effects encompass both observed variables such as

central bank independence and unobservables such as tastes and preferences for low inflation. This "within regression" may be written as:

$$INFLATION_{it} = \sum_{i}^{N} d_i + b_2 * UDENS_{it} + b_3 * UDEN2_{it} + b_4 * UCONC_{it} + e_{it}$$

where the d_i's are country dummies. The estimated parameters indicate how much time variations in union density and concentration explains the evolution of inflation in each country. Since our measure of CBI is fixed for each country, it is subsumed in the country fixed effect.

The loss of degrees of freedom arising from using fixed effects estimation can be avoided if we assume that the country-specific effects are random. The random effects model (implemented by using generalized least squares) is an appropriate specification if we are drawing the countries in our sample randomly from a larger population (such as all the OECD countries). In the two-way error component regression model, we also allow for a time (year) effect to absorb shocks that impact all countries in the sample in a given year. This in some sense accounts for the autocorrelation we observe in the inflation data, since in our sample period (1971-85) all the countries were affected by the two OPEC shocks. The random effects or variance components model is given by:

$$INFLATION_{it} = a + m_i + l_t + b_1 * CBI_i + b_2 * UDENS_{it} + b_3 * UDEN2_{it} + b_4 * UCONC_{it} + e_{it}$$

The validity of the random effects model hinges on the independence of the individual invariant effects from the other dependent variables and the *i.i.d.* disturbance term. When the independence criteria is satisfied, the GLS estimator is BLUE, consistent and asymptotically efficient, but is otherwise biased and inconsistent. On the other hand, the "within" (fixed effects) estimator is consistent whether or not the independence criteria is satisfied. Based on these differences, the Hausman test may be used to discriminate between these two specifications.

We similarly use the "between", fixed effects and random effects estimators in the unemployment regressions.

IV. Empirical Results

4.1 Aggregate Data (OLS Estimation)

Table 4a presents the results from the basic OLS specification. The first column shows the estimates using all ten countries in the sample while the second column shows the corresponding estimates when the UK is excluded. In line with many previous studies, greater central bank independence appears to be associated with lower inflation. The estimated coefficients imply that an increment of 0.10 in the central bank independence measure (which varies between 0 and 1, with the highest value in this sample attained by Germany (0.69) and the lowest by Norway (0.17)) reduced inflation by roughly 1% in the full sample and approximately 0.7% in the sample excluding the UK. In both cases, union density exhibits the inverted U-shape that is predicted by our theory – the estimates for union density are positive and statistically significant while the estimates for union density squared are negative and significant. In Fig. 2, we plot the relationship between inflation and union density with the UK excluded.[6] In the full sample, the measure of union concentration has the right sign but is statistically insignificant at the 10% level. In line with the explanation given earlier concerning the anomaly in the UK, union concentration becomes significant at 5% (with a *t*-statistic of –3.25) when the UK observations are dropped.[7]

In columns 3 and 4 of Table 4a, we include union coverage (the percentage of the workforce covered by collective bargaining agreements) first as a substitute for union density (column 3) and

[6] In this plot, we use the estimated coefficients found in column 2 of Table 4. CBI and union concentration are imputed their mean values to obtain a plausible vertical intercept for the curve.

then as an additional variable characterizing collective bargaining structures in each country (column 4). As Flanagan (1999) has pointed out, even in countries where legal extension of collective bargaining coverage does not exist, union influence will less visibly exceed union membership to the extent that some nonunion employers adopt wages, benefits and other features of union contracts to try to pre-empt their employees' attempts at unionization. Our results show that union coverage is a poor replacement for union density, and the inclusion of union coverage does not undermine the explanatory power of union density and union concentration in our inflation regression. (In fact, the *t*-values on union density, union density squared and union concentration all rise, as can we seen in column 4.)

In the penultimate column of Table 4a, we attempt to control for the aggregate demand and supply balance in each year for every country in our sample by including a de-trended average weekly hours-worked variable. The inclusion of this variable is somewhat problematic, however. Since tax brackets are not indexed to inflation in most countries, higher inflation may reduce the incentive for working longer hours, making the hours worked variable endogenous. Indeed, the inclusion of direct or indirect measures of a government's policy stance (such as the unemployment rate) will also lead to simultaneity bias. Fortunately, although the hours-worked variable itself is statistically significant at the 10% level, its inclusion has minimal effect on the explanatory power of union density and union concentration. Central bank independence, however, has a reduced point estimate and now becomes statistically insignificant.

Lastly, to address a criticism Flanagan (1999) has made of almost all previous studies, we control for the impact of imports on the union span of control in product markets with an openness to trade variable (measured as the ratio of imports to GDP). The openness variable is a potentially

[7] From this point on, we will exclude the UK in *all* subsequent regressions except those reported in section 5.2, where we reinstate the UK observations but add dummies to account for the level at which wage bargaining takes

crucial one, since theory clearly predicts that institutional impact should vary with the scope of international trade. As reported in the last column of Table 4a, the openness variable is highly statistically significant (with a *t*-statistic of –5.30), but it does not weaken the impact of the union variables in any way. In fact, the statistical relationships between inflation and CBI, union density and union concentration all become stronger (compare the *t*-values with those in column 2).

The first column in Table 4b repeats the results from the baseline specification excluding the UK (column 2 in Table 4a). The second column shows that the relationship between CBI and inflation takes a linear rather than quadratic. In column 3, we see that the estimated relationship between inflation and union concentration exhibits apparent concavity. However, when we plot the relationship using the means of all other variables, the concavity appears mild and is very sensitive to outlying observations in union concentration (specifically those of Austria, where the Herfindahl index is constant at 1).

In the last column, we report the results obtained when interaction terms between CBI and union density, union density squared and union concentration are added to the estimated equation. The interactions of CBI and union density or density squared are statistically insignificant, in contrast to that between CBI and union concentration, possibly suggesting that a country's underlying preferences for inflation are reflected in both its monetary institutions and certain aspects of its labor market. Compared to the baseline equation in column 1, CBI has a much higher point estimate (-39.88) but becomes less statistically significant (now only so at the 10% level), while the *t*-statistic for union concentration rises slightly in absolute value from –3.25 to –3.54.

Summarizing our initial findings, we showed that inflation is negatively correlated with central bank independence and union concentration, while there exists a hump-shaped relationship between inflation and union density. This is related to the finding of Calmfors and Driffill (1988)

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place.

that there is a hump-shaped relationship between inflation and the degree of centralization of wage bargaining.[8]

TABLE 4A

Inflation, central bank independence, and wage-bargaining structure in 10 OECD countries, 1971-85.

Dependent variable: annual consumer price inflation (%)
Estimation method: **OLS**

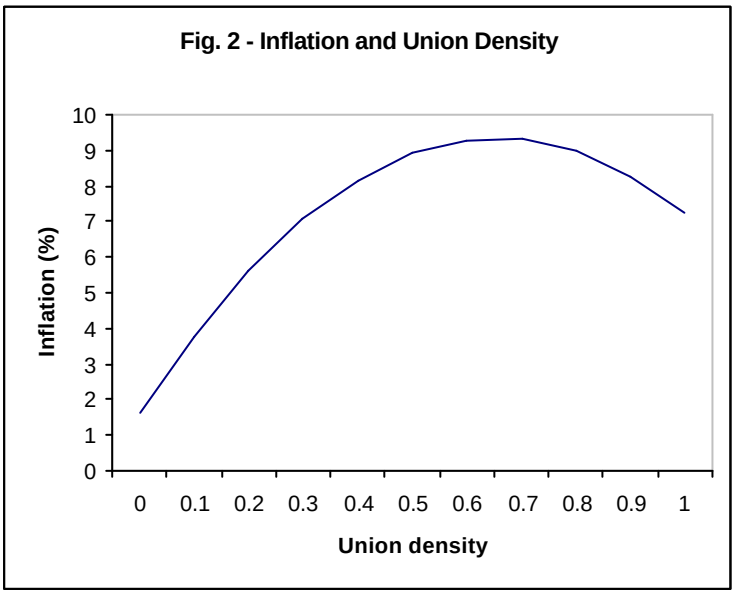
Countries	All	No UK	No UK	No UK	No UK	No UK
Independent variables						
constant	8.57	7.96	13.22	0.83	1.21	8.88
	(4.05)	(4.15)	(5.47)	(0.21)	(0.30)	(5.06)
Central bank inde-	-10.09 **	-6.72 **	-8.70 **	-3.66	-3.59	-6.47 **
pendence	(-1.86)	(-3.42)	(-4.13)	(-1.49)	(-1.45)	(-3.62)
Union density	21.86 **	23.57 **	------	32.72 **	32.33 **	43.20 **
	(2.28)	(2.72)		(3.37)	(3.32)	(4.96)
Union density squared	-18.02 **	-17.95 **	------	-24.93 **	-24.64 **	-34.78 **
	(-2.11)	(-2.33)		(-2.98)	(-2.94)	(-4.53)
Union coverage	------	------	-0.05	7.36 **	------	------
			(-0.02)	(2.01)		
Herfindahl index of	-2.91	-6.66 **	-2.34	-11.71 **	-11.64 **	-8.80 **
union concentration	(-1.52)	(-3.25)	(-1.07)	(-3.63)	(-3.60)	(-4.61)
Detrended weekly	------	------	------	------	6.96 *	------
hours worked					(1.88)	
Openness (share of	------	------	------	------	------	-16.01 **
Imports In GDP)						(-5.30)

[8] By contrast, the theoretical model of Velasco and Guzzo (1998) generates the prediction that inflation and centralization of wage bargaining are either negatively related (when the elasticity of substitution among different types of labor is sufficiently small) or exhibit a U-shaped relationship (when the elasticity is sufficiently large).

TABLE 4B

Countries	No UK			
Independent variables				
constant	7.96	6.72	11.33	18.33
	(4.15)	(2.30)	(5.09)	(2.87)
Central bank independence	-6.72 **	-0.07	-5.41 **	-39.88 **
	(-3.42)	(-0.01)	(-2.75)	(-1.68)
CBI squared	------	-7.98	------	------
		(-0.56)		
Union density	23.57 **	23.85 **	37.47 **	46.20
	(2.72)	(2.74)	(3.82)	(1.23)
Union density squared	-17.95 **	-18.57 **	-27.46 **	-37.54
	(-2.33)	(-2.38)	(-3.34)	(-1.11)
Herfindahl index of union	-6.66 **	-6.35 **	-34.43 **	-44.79 **
concentration	(-3.25)	(-2.98)	(-3.40)	(-3.54)
Union concentration squared	------	------	19.82 **	------
			(2.80)	
CBI x union density	------	------	------	25.70
				(0.21)
CBI x union density squared	------	------	------	-11.11
				(-0.10)
CBI x union concentration	------	------	------	57.34 **
				(2.49)

Notes: Figures in parentheses are *t*-statistics. ** indicates statistical significance at the 5% level, * indicates significance at the 10% level. Data on the *openness* variable in Table 4a from the OECD dataset



4.2 Robustness Checks with Alternative Estimators

We now report the results obtained by using the various estimators discussed in Section III. As our measure of central bank independence is time-invariant, and with relatively little time variation in union density and union concentration, we are concerned that the OLS estimates may be biased should our observations not be truly independent across time and countries (so that the *i.i.d* assumption required for OLS to be consistent is violated). To obtain more conservative estimates of the impact of CBI and union variables on inflation, we therefore present four alternative estimators. The first and second are the "between" and "within" (fixed effects) regressions. The third is the Fuller-Battese implementation of the variance components (random effects) model, where the error term has a time component, a component unique to a cross section, and an *i.i.d.* component. Bearing in mind that serial correlation is often endemic to inflation data, the fourth estimator we look at is the autoregressive model (using the Parks method), where the error term is assumed to be autocorrelated. We also allow for heteroscedasticity and for the errors to be contemporaneously correlated.

In the "within regression" (column 1) where the average inflation rate for each country is regressed on its CBI and average union density and concentration, CBI is shown to be powerful explanatory variable for cross-country differences in average inflation rates (with a *t*-statistic of –2.24 in a regression with only 9 observations).[9] In the fixed effects estimation (reported in column 2), the relatively small time variations in union density turns out to explain much of the fluctuations in annual inflation rates in the sample. As in the OLS estimates, the relationship between inflation and union density in the "within regression" is a hump-shaped one (both union density and density

[9] When we replace the union density and density squared variables with union coverage, the *t*-statistic for CBI rises in magnitude to –2.60 while union concentration and union coverage itself have *t*-values of 0.25 and –0.62 respectively.

squared have *t*-statistics greater than 3 in absolute value). Union concentration loses its statistical significance but retains the expected sign.

In the variance components model, central bank independence loses its explanatory power for inflation (see column 3 in Table 5). Union density remains statistically significant while density squared does not, although the signs for both remain correct. More importantly, the union concentration variable retains the predicted sign and is highly significant. Note that the Hausman test confirms the validity of the random effects specification. When we turn to the estimates in column 4, we see that the Parks autoregressive model (which takes into account autocorrelation in inflation[10]) validates the robustness of our result that union concentration is negatively correlated with inflation. In this instance, central bank independence is significant at the 10% level and is of the correct sign; union density and density squared retain the predicted signs but become statistically insignificant. As might be expected, the point estimates for all the explanatory variables in this specification are smaller in magnitude than those under OLS. Serial correlation tends to increase the parameter estimates as data points for each country cluster together with regard to dependent variables like inflation. So countries with high inflation in one year tend to have persistently high inflation for the rest of the sample period, while the reverse is true for low inflation countries. Accounting for the serial correlation in the data "spreads out" the data points for each country, reducing the slope of the line of best fit in the case of a simple regression and the magnitude of the parameter estimates in a multiple regression. The reduction in the *t*-statistics may be explained by the fact that accounting for serial correlation is akin to reducing the number of independent data points or observations.

[10] When we plot the residuals from the OLS regression (column 2, Table 4), the autocorrelation is highly evident. See Table 5 for the autocorrelation coefficients in the GLS (Parks) autocorrelation-corrected regression.

Together these results suggest that central bank independence, union density and union concentration are all key elements in the inflation puzzle we are attempting to decipher. Their relative importance, however, vary depending on the specification chosen and the estimator used.

TABLE 5

Inflation, central bank independence, and wage-bargaining structure in 9 OECD countries, 1971-85.

Dependent variable: annual consumer price inflation (%)
Estimation method: **OLS, FE, GLS**
All countries except UK

Method	"Between"	Fixed Effects ("Within")	Random Effects (*Fuller-Battese*)	Autoregression (*Parks*)
Independent variables				
Intercept	8.99	------	6.13	7.32
	(1.49)		(1.49)	(7.27)
Central bank independence	-10.81 **	------	-2.10	-4.73 *
	(-2.24)		(-0.40)	(-1.90)
Union density	21.75	83.31 **	27.18 **	12.65 *
	(0.75)	(3.89)	(1.92)	(1.76)
Union density squared	-20.62	-52.67 **	-14.46	-8.90
	(-0.75)	(-3.24)	(-1.19)	(-1.35)
Herfindahl index of union concentration	-1.97	-9.47	-12.48 **	-3.52 **
	(-0.40)	(-1.12)	(-3.07)	(-2.32)

Hausman test for random effects model: m value = 4.9373 Prob. > m = 0.1764

Autocorrelation coefficient in Parks estimation: *rho* = 0.70, 0.52, 0.70, 0.88, 0.74, 0.96, 0.71, 0.38, and 0.51 for the respective countries.

Notes: Figures in parentheses are *t*-statistics. ** indicates statistical significance at the 5% level, while * indicates significance at the 10% level.

4.3 The Level of Wage Bargaining

While we have stressed the importance of union concentration and union density in explaining differences in inflation between countries, we have implicitly assumed that wage bargaining takes place at the same level in all countries. We have already seen this assumption causes serious

problems in the case of UK, where union concentration is high (with a single union confederation) but actual wage bargaining takes place at the level of the firm. This poor coordination and synchronization of wage bargains predictably lead to the relatively high inflation rates observed in the UK.

One obvious way of controlling for these differences in the level at which wage bargains take place is to include dummies for national-level bargaining and firm-level bargaining, with industry-level bargaining as the default. Our prediction is that national-level bargaining increases synchronization and improves coordination between unions, thereby reducing the incidence of leapfrogging and reducing wage and price inflation. The opposite prediction is made for firm-level bargaining. In our sample of 10 countries, unions and firms engage in industry-level bargaining in 5 countries. In the Scandinavian countries (Denmark, Norway and Sweden) wages bargains are made at the national level, while Switzerland and UK are characterized by firm-level bargaining. (For more details, refer to Appendix A.)

Table 6 shows the result of including wage bargaining level dummies. Note that we are using the random effects model, estimated by generalized least squares with the Fuller-Battese method. Comparing the estimates shown in column 1 and 2, we see that the inclusion of the bargaining level dummies increases the point estimates and the statistical significance of all the explanatory variables. Central bank independence, union density and union concentration now become significant at the 5% level The dummy variables for national-level and firm-level wage bargaining have the expected sign and the one for national-level bargaining is highly significant (with a *t*-statistic of –2.90). These results are qualitatively unchanged when we switch to the Parks autoregression model (see column 3). Relative to industry-level bargaining, bargaining for wages at the national level improves inflation outcomes while bargaining at the firm level has deleterious

effects on price stability. In summary, accounting for the level at which wage bargains take place strengthens, rather than weakens, our results.

TABLE 6

Inflation, central bank independence, and wage-bargaining structure, and the wage bargaining level in 10 OECD countries, 1971-85.

Dependent variable: annual consumer price inflation (%)
Estimation method: **GLS – Fuller-Battese, Parks**

Countries	All (including UK)		
Independent variables		*Fuller-Battese*	*Parks*
Intercept	6.95	6.78	6.06
	(1.59)	(1.69)	(3.71)
Central bank independence	-6.72	-10.92 **	-10.37**
	(-1.34)	(-2.38)	(-3.96)
Union density	21.85	31.54 **	33.98**
	(1.39)	(2.07)	(5.14)
Union density squared	-9.67	-11.03	-19.81**
	(-0.72)	(-0.87)	(-3.82)
Herfindahl index of union	-6.98 *	-8.59 **	-6.91**
concentration	(-1.79)	(-2.37)	(-5.01)
Dummy for national-level	------	-6.83 **	-5.11**
Bargaining		(-2.90)	(-4.21)
Dummy for firm-level bargaining	------	1.54	1.52
		(0.77)	(1.45)

Hausman test for random effects model in column 2: m value = 1.3410 Prob. > m = 0.7194

Notes: Figures in parentheses are *t*-statistics. ** indicates statistical significance at the 5% level, while * indicates significance at the 10% level.

4.4 Low vs. High-Union Concentration Countries

Table 7 presents the results obtained when the sample of 9 countries (UK excluded) is divided into 3 groups of equal size with high, medium, and low union concentration. Table 8 shows how these groups differ with regard to the key variables. The results indicate that there are surprisingly significant differences in the relationships between inflation, CBI and union density among the three groups.

In the first column of Table 7, we hypothesize that the effect of central bank independence on inflation differs between groups[11]. For the group of countries with high union concentration, greater central bank independence is associated lower inflation while union density has no significant explanatory power for inflation. For the group with medium union concentration, CBI is significant but has the wrong sign (with the estimates suggesting that greater CBI is associated with higher inflation). This points to the possibility of simultaneity in the relationship between inflation and CBI, with countries in this group who are suffering from high inflation perhaps choosing to institute greater independence in their central banks. Union density is significant at the 10% level while density squared is significant at 5%. Finally, for the group of three countries with relatively low degrees of central bank independence, union density and density squared are significant factors in explaining inflation while central bank independence is not.

In the second column, we postulate that the relationship between CBI and inflation not only varies across the three groups, but it is quadratic in nature. The results indicate that there is a U-shaped relationship between CBI and inflation in the low-concentration group, in contrast to the hump-shaped relationship in the medium-concentration group. There is no statistically significant relationship between CBI and inflation in the high-concentration group.

In column 3, we present the results from our random effects / variance components model estimated by GLS using the Fuller-Battese method. As in Table 5, CBI has little explanatory power for inflation once we take into account country-specific (random) effects, although CBI now has the predicted sign for all three groups. The point estimates for union density and density squared becomes considerably larger for the medium and high concentration groups, and so do their corresponding *t*-statistics. The qualitative relationships between union density and inflation,

[11] An alternative specification with the restriction that CBI has a common effect on all three groups of countries was rejected by an *F*-test on the restriction.

however, are unchanged from the OLS case: inflation and union density exhibit a hump-shaped relationship in the medium concentration group, an U-shaped relationship in the low concentration group, and no relationship in the high concentration group.

TABLE 7

Inflation, central bank independence, and wage-bargaining structure in 9 OECD countries (excluding UK), 1971-85.

Dependent variable: annual consumer price inflation (%)
Estimation method: **OLS, GLS (Random Effects Model)**

Countries	All except UK		
	Specification		
Independent Variables	1 (*OLS*)	2 (*OLS*)	3 (*GLS*)
Hi (dummy for high density group)	37.98	94.12	55.81
(1.94)	(-0.58)	(0.94)	
Hi x CBI	-39.77 **	-350.02	-43.28
	(-2.19)	(-0.76)	(-0.63)
Hi x CBI squared	------	284.79	------
		(0.67)	
Hi x union density	-17.95	59.45	-73.66
	(-0.56)	(0.50)	(-0.88)
Hi x density squared	7.84	-45.45	54.28
	(0.32)	(-0.55)	(0.93)
Med (dummy for medium density group)	-20.18	-289.49 **	-39.35
	(-1.29)	(-6.08)	(-1.57)
Med x CBI	52.31 **	214.20 **	-37.12
	(3.70)	(6.03)	(-0.39)
Med x CBI squared	------	-4918.67 **	------
		(-5.89)	
Med x union density	73.02 *	160.70 **	137.19 **
	(1.72)	(4.10)	(4.96)
Med x density squared	-65.19 **	-91.48 **	-68.59 **
	(-2.05)	(-3.31)	(-3.55)
Lo (dummy for low density group)	26.12 **	43.48 **	25.74 *
	(3.26)	(5.13)	(1.77)
Lo x CBI	2.11	-160.07 **	-0.66
	(0.43)	(-3.45)	(-0.02)
Lo x CBI squared	------	165.31 **	------
		(3.50)	
Lo x union density	-135.02 **	-57.41	-135.07 **
	(-1.99)	(-0.92)	(-3.04)
Lo x density squared	219.12 *	163.34	236.83 **
	(1.90)	(1.63)	(3.39)

Notes: Figures in parentheses are *t*-statistics. ** indicates statistical significance at the 5% level, while * indicates significance at the 10% level.

TABLE 8
Characteristics of high, medium and low union concentration groups.

Variables *Group*	Average CBI	Average inflation (%)	Average union density	Average union concen-tration	Av unem-ploy-ment (%)
High concentration (Austria, Denmark, Germany)	0.60	6.58	0.57	0.74	5.63
Medium concentration (Italy, Norway, Sweden)	0.24	10.62	0.65	0.47	3.78
Low concentration (France, Netherlands, Switzerland)	0.43	7.70	0.29	0.31	5.18

V. Union Variables and Unemployment

In the preceding sections, we showed that union density and union concentration are important determinants of a country's inflationary experience. Other studies, such as Bleaney (1986), have concluded that wage institutions also affect the unemployment rates of countries. The argument made is that the degree of centralization of wage negotiations affects the extent to which unions push for higher *real* wages. With higher real wages, the quantity of labor demanded by firms fall, leading to lower output and employment levels and higher unemployment rates. In addition, the degree of central bank independence may be expected to influence the stance of monetary policy in each country. An independent central bank presumably has a freer hand in restraining inflation by pursuing a tight money policy. Unlike politicians who have to answer to an electorate usually more concerned with jobs than inflation, independent central bankers face little political pressure to keep unemployment low at the expense of price stability. An alternative way of thinking about it is that union variables shift the Phillips curve for each country, while CBI determines the point it is at on the curve.

Table 9 shows the impact of central bank independence and union variables on the annual unemployment rate for 9 OECD countries (UK excluded). In the random effects model without interaction terms (column 1), we see that there is no relationship between unemployment and CBI. Unemployment exhibits a U-shaped relationship with union density and a positive relationship with union concentration. The U-shaped result is counter-intuitive, since we expect coordination failure in wage setting to be most acute at an intermediate level of unionization for the same reason as that for inflation. At intermediate levels of union density, unions are most likely to push for higher nominal wages, which results in higher real wages and unemployment for any given amount of accommodation by the central bank (proxied here by CBI). The positive relationship between unemployment and union concentration may perhaps be explained by the rise in the monopsonistic power of unions to set higher real wages for insiders as they become more concentrated. This effect apparently dominates the salubrious effect higher union concentration has on coordination in wage bargaining[12]. These results are broadly unchanged when we switch from the random effects model to the Parks autoregression model (see column 3).

The results (shown in column 2) are somewhat different when interaction terms between central bank independence and union density, density squared and union concentration are included. The interactions between CBI and union density are statistically significant while that between CBI and union concentration is not. We see that again CBI has no statistically significant impact on unemployment, while greater union concentration raises unemployment (*t*-statistic = 2.07). Unlike the results in column 1, there is now strong evidence of a hump-shaped relationship between union

[12] More concentrated union confederations should have greater concern about the decrease in employment that results from their raising real wages, since the unemployed are less likely to be absorbed by other industries / unions. Fragmented unions, on the hand, may not worry about the employment effects of their wage push, since those not employed could be assumed to be able to find employment and membership in one of the many other small union confederations.

density and unemployment. Calmfors and Driffill (1988) and Bleaney (1986) have found a similar-shaped relationship between centralization of wage bargaining and unemployment.

In column 4, we report the estimates of the unemployment regression when we include three measures of the unemployment benefit system. These systems vary widely across our sample countries: barely existent in Italy, generous but fixed term in the Scandinavian countries, and generous and long-term or indefinite in much of continental Europe. We predict that more generous unemployment benefits will result in higher unemployment rates through their impact on the unemployed's incentive to undertake serious job search. Our results indicate that a higher replacement ratio (unemployment benefits as a fraction of the recipient's earnings in his/her last job) raises unemployment. Similarly, greater expenditure on unemployment benefits per unemployed person (as a percentage of output per worker) increases the unemployment rate. However, the duration of unemployment insurance appears to have no discernible impact on unemployment.

TABLE 9

Unemployment, central bank independence, and wage-bargaining structure in 10 OECD countries, 1971-85.

Dependent variable: annual unemployment rate (%)
Estimation method: **GLS**

Countries	No UK			
Independent variables	← Fuller-Battese →		← Parks →	
Constant	14.81	9.01	10.47	12.90
	(4.21)	(1.49)	(5.50)	(5.14)
Central bank independence	-6.06	16.04	-3.87 **	-6.17 **
	(-1.11)	(0.97)	(-2.29)	(-3.30)
Union density	-46.24 **	4.27	-28.73 **	-35.13 **
	(-5.10)	(0.21)	(-4.62)	(-5.06)
Union density squared	35.59 **	-46.78 **	23.49 **	24.79 **
	(4.79)	(-2.73)	(4.70)	(4.43)
Union concentration	8.63 **	14.32 **	2.87 **	3.63 **
	(2.97)	(2.07)	(2.07)	(2.80)
CBI x union density	------	-130.74 **	------	------
		(-2.37)		
CBI x union density squared	------	206.45 **	------	------
		(4.48)		
CBI x union concentration	------	-19.51	------	------
		(-1.19)		
Replacement ratio (in 1985)	------	------	------	-4.29 **
				(-2.12)
Unemployment insurance	------	------	------	0.28
duration (in 1985)				(0.36)
Benefit expenditure	------	------	------	14.93
				(3.12)

Notes: Figures in parentheses are *t*-statistics. Data on replacement ratio, duration of unemployment insurance and expenditure on benefits per unemployed person (as % of output per worker) from OECD, *Employment Outlook*, Sept. 1988.

VI. CBI and the Impact of Union Variables on Macroeconomic Outcomes

We now investigate how differently union variables impact inflation and unemployment in countries with low central bank independence vis-à-vis those with high central bank independence. The countries classified as the high CBI group are Germany (with a CBI measure of 0.69),

Switzerland (0.64), Austria (0.61), Denmark (0.50) and the Netherlands (0.42). The low CBI group comprises Norway (0.17), France (0.24), Italy (0.25) and Sweden (0.29). On average, the countries in the high CBI group had more concentrated union confederations, and experienced lower inflation but higher unemployment (as might have been expected).

From Table 10, we observe that union density has a similar impact on inflation in both groups of countries. However, union concentration has a much stronger impact on inflation in countries with high CBI. This result is in conflict with the intuition that coordination between unions matter more when the central bank is incapable of keeping inflation low by itself. As with all regressions using the random effects estimator, CBI has no statistically significant impact on inflation for either group.[13]

The estimates presented in Table 11 indicate that an increase in CBI has little impact on unemployment for countries with already high CBI but a positive impact (significant statistically at the 10% level) for those with low CBI. Union density exhibits a U-shaped relationship with inflation in the high CBI group and a negative relationship in the low CBI group. Greater union concentration results in higher unemployment for both groups of country. This may be attributable to the "monopsony" effect dominating the "coordination" effect, as explained previously.

[13] The Parks autoregressive model yields similar results for CBI and union density. Union concentration , on the other hand, exerts a greater effect on inflation for countries with low CBI (estimates not shown).

TABLE 10

Inflation, central bank independence, and wage-bargaining structure in 10 OECD countries, 1971-85.

Dependent variable: annual CPI inflation rate (%)
Estimation method: **GLS (Random Effects Model)**

Countries / *Independent variables*	High CBI	Low CBI
constant	-3.17	-2.89
	(-0.53)	(-0.18)
Central bank independence	3.41	10.96
	(0.69)	(0.19)
Union density	40.45	30.90
	(1.87) *	(1.60)
Union density squared	-26.11	-18.18
	(-1.40)	(-1.15)
Herfindahl index of	-8.27	0.89
union concentration	(-3.15) **	(0.07)

Notes: Figures in parentheses are *t*-statistics.

TABLE 11

Unemployment, central bank independence, and wage-bargaining structure in 10 OECD countries, 1971-85.

Dependent variable: annual unemployment rate (%)
Estimation method: **GLS (Random Effects Model)**

Countries / *Independent variables*	High CBI	Low CBI
constant	36.24	1.01
	(4.00)	(0.17)
Central bank independence	-20.13	34.43 *
	(-1.41)	(1.65)
Union density	-93.58 **	-23.55 **
	(-7.19)	(-3.17)
Union density squared	82.04 **	5.47
	(8.02)	(0.89)
Herfindahl index of	5.28	12.71 **
union concentration	(1.63)	(2.41)

Notes: Figures in parentheses are *t*-statistics.

VII. Conclusion

In this paper, we have investigated the impact of central bank independence, union density and union concentration on inflation and unemployment in a macroeconomic environment characterised by severe negative aggregate supply shocks and their aftermath.

While previous studies in this field have used subjective measures of centralization and corporatism to capture the degree to which a country's wage setting institutions ameliorate the effects of coordination failures, we devised a Herfindahl index of union concentration which is more objective and captures much of the subtleties inherent in the phenomena under study. Other variables used to characterize the labor market institutions in a country are union density and the level at which wage bargaining takes place.

Our results using a panel from 10 OCED countries (1971-85) show that, controlling for central bank independence, union density and union concentration have little effect on unemployment but have a significant impact of price inflation. There exists a hump-shaped relationship between union density and inflation, and a negative relationship between union concentration and inflation. These results are mostly robust across different estimators (ordinary least squares, fixed effects, and feasible generalized least squares) and across various assumptions about the structure of the error terms. Similarly, taking into account the different levels at which wage bargaining takes place across countries only strengthened our findings. Moreover, we find that the relative importance of central bank independence and union density in explaining inflation rates varies considerably across countries grouped by their levels of union concentration.

Turning our attention to unemployment, we find a possibly positive relationship between central bank independence and unemployment, a non-linear relationship between union density and unemployment, and a positive relationship between union concentration and unemployment. As in

the case of inflation, the impact of union variables on unemployment varies with the independence of the monetary authority.

References

Addison, John T. (1984). 'Trade Unions, Corporatism, and Inflation', *Journal of Labor Research*, 5 (1), 39-62.

Amadeo, Edward J. (1994). 'Institutions, Inflation and Unemployment', Edward Elgar Publishing, Aldershot, UK.

Barro, Robert J. and D.B. Gordon (1983). 'A Positive Theory of Monetary Policy in a Natural State Model', *Journal of Political Economy*, 91, 589-610.

Bean, C. (1994). "European Unemployment: A Retrospective", *European Economic Review*, 38, 423-34.

Bleaney, Michael (1993). 'The Structure of Wage Bargaining and Macroeconomic Performance: A Theoretical Analysis", *Greek Economic Review*, 15 (2), 65-72.

_____ (1996). 'Central Bank Independence, Wage-Bargaining Structure, and Macroeconomic Performance in OECD Countries', *Oxford Economic Papers*, 48, 20-38.

Bruno, Michael and Jeffrey Sachs (1985). *Economics of Worldwide Stagflation*, Basil Blackwell, Oxford.

Calmfors, Lars and John Driffill (1988). 'Bargaining Structure, Corporatism and Macroeconomic Performance', *Economic Policy*, 6, 14-47.

Campillo, Marta and Jeffrey A. Miron (1997). 'Why Does Inflation Differ Across Countries?' in Christina D. Romer and David H. Romer (ed.) *Reducing Inflation: Motivation and Strategy*, The University of Chicago Press, Chicago.

Chou, Yuan K. (2000). 'The Effect of Collective Bargaining and Central Bank Independence on Inflation and Unemployment: Evidence from the OECD", University of Melbourne Department of Economics Research Paper No. 770.

Coricelli, Fabrizio, Alex Cukierman and Alberto Dalmazzo (2000). "Monetary Institutions, Monopolistic Competition, Unionized Labour markets and Economic Performance", CEPR Discussion Paper No. 2407.

Crouch, Colin (1985). 'Conditions for Trade Union Wage Restraint', in L. Lindberg and C.S. Mail (ed.) *The Politics of Economic Stagflation*, Brookings Institution, Washington D.C.

Cubitt, Robin P. (1995). 'Corporatism, Monetary Policy and Macroeconomic Performance: A Simple Game Theoretic Analysis', *Scandinavian Journal of Economics*, 97 (2), 245-259.

Cukierman, A. and F. Lippi (1999). 'Central Bank Independence, Centralization of Wage Bargaining, Inflation and Unemployment – Theory and Some Evidence', *European Economic Review*, 43(7), 1395-1434.

Cukierman, A., Fabrizio Coricelli and Alberto Dalmazzo (2001). "Economic Performance and Stabilization Policy in a Monetary Union with Imperfect Labour and Goods Markets ", CEPR Discussion Paper No. 2745.

Cukierman, A., Webb, S. B., and B. Neyapti (1992). 'Measuring the Independence of Central Banks and Its Effect on Policy Outcomes', *World Bank Economic Review*, 6, 353-98.

Dolton, Peter and Martin Robson (1996). 'Trade Union Concentration and the Determination of Wages: The Case of Teachers in England and Wales', *British Journal of Industrial Relations*, 34 (4), 539-55.

Dowrick, S. (1993). "Wage Bargaining Systems and Productivity Growth in the OCED", Offices of EPAC, Australian Government Publishing Service, Background Paper No. 26, Canberra.

Freeman, Richard B. (1988). 'Labour Market Institutions and Economic Performance', *Economic Policy*, 6, 65-80.

Fuller, W.A. and Battese, G.E. (1974). 'Estimation of Linear Models with Crossed-Error Structure," *Journal of Econometrics*, 2, 67-78.

Golden, Miriam, Lange, Peter, and Michael Wallerstein (1997). "Union Centralization Among Advanced Industrial Societies: An Empirical Study."

Greene, William H. (1993). *Econometric Analysis*, New York: Macmillan Publishing Company.

Grier, K. (1997). "Governments, Unions and Economic Growth" in Bergstrom W. (ed.) *Governments and Growth*, Oxford University Press, Cambridge.

Grilli, V., Masciandaro, D., and Tabellini, G. (1991). 'Political and Monetary Institutions and Public Financial Policies in the Industrial Countries', *Economic Policy*, 13, 341-92.

Hall, P. and R. Franzese (1996). 'The Mixed Blessing of Central Bank Independence and European Monetary Union', mimeo.

Heitger, B. (1987). "Corporatism, Technological Gaps and Growth in OECD Countries", Weltwirtshaftliches Archiv, 123, 463-473.

Hsiao, C. (1986). *Analysis of Panel Data*, Cambridge: Cambridge University Press.

Kydland, Finn and Edward Prescott (1977). 'Rules Rather Than Discretion: The Inconsistency of Optimal Plans', *Journal of Political Economy*, 87, 473-492.

Layard, Richard, Nickell, S. and R. Jackman (1991). *Unemployment: Macroeconomic Performance and the Labor Market*, Oxford University Press, New York.

Newell, A. and Symons, J. S. V. (1987). 'Corporatism, Laissez-Faire and the Rise in Unemployment', *European Economic Review*, 31, 567-605.

OECD (1997). "Economic Performance and the Structure of Collective Bargaining", *Employment Outlook*, July 1997, pp. 63-92.

Parks, R.W. (1967). 'Efficient Estimation of a System of Regression Equations when Disturbances Are Both Serially and Contemporaneously Correlated', *Journal of the American Statistical Association*, 62, 500-509.

Rogoff, K. (1985). 'The Optimal Degree of Commitment to an Intermediate Monetary Target', *Quarterly Journal of Economics*, 100, 1169-90.

Rowthorn, R. E. (1992). "Corporatism and Labour Market Performance" in Pekkarinen, J., Pohjola, M. and R. Rowthorn (eds.), *Social Corporatism: A Superior Economic System*, Clarendon Press, Oxford.

SAS Institute Inc. (1979). SAS Technical Report S-106, *TSCSREG: A SAS Procedure for the Analysis of Time-Series Cross-Section Data*, Cary, NC: SAS Institute Inc.

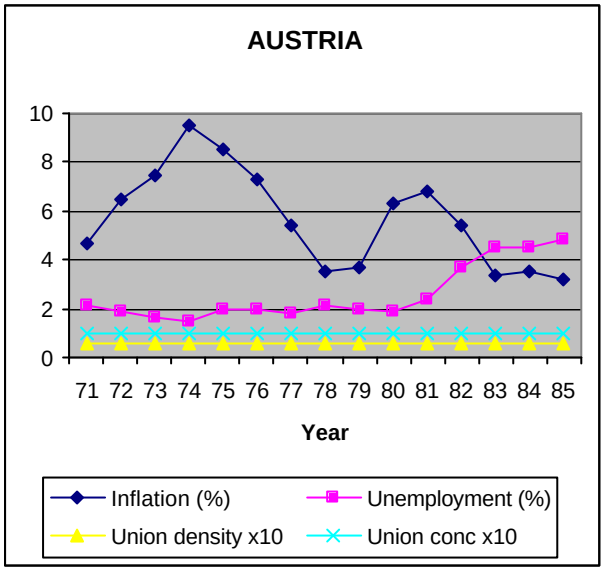
Scarpetta, S. (1996). "Assessing the Role of Labor Market Policies and Institutional Settings on Unemployment: A Cross-Country Study", *OECD Economic Studies*, no. 26, 43-98.

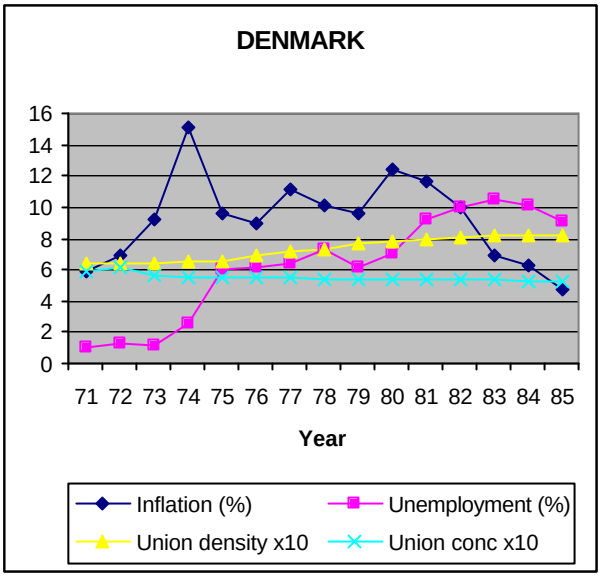
Soskice, David. (1990). "Wage Determination: The Changing Role of Institutions in Advanced Industrialized Countries", *Oxford Review of Economic Policy*, 6, 36-61.

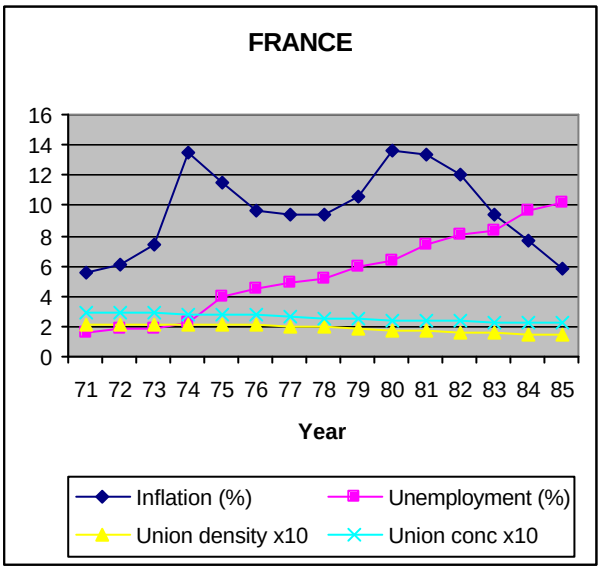
Soskice, David and Torben Iversen (2000). "The Non-Neutrality of Monetary Policy with Large Price or Wage Setters", *Quarterly Journal of Economics*, 115(1), 265-284.

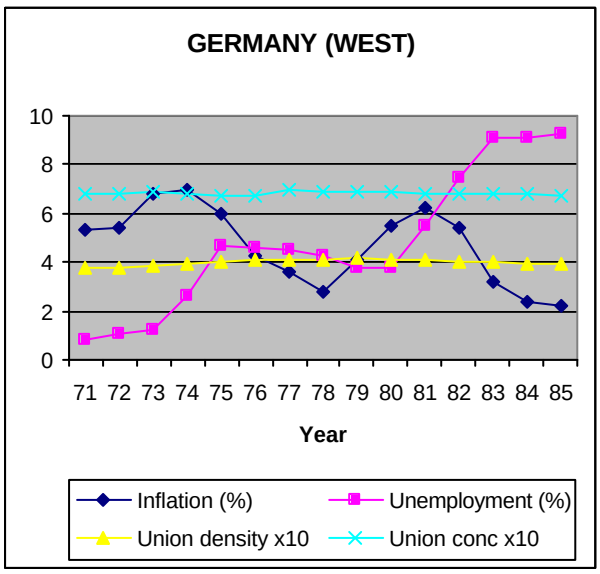
Traxler, F., Kiltel, B. and S. Lengauer (1996). "Globalization, Collective Bargaining and Performance", University of Vienna, mimeo.

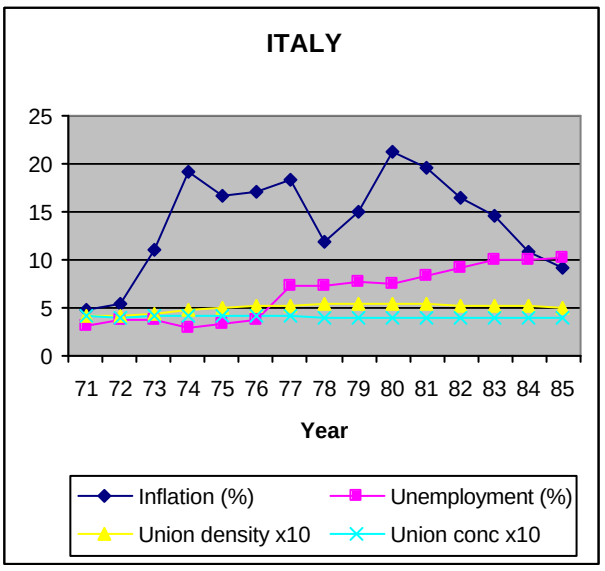
Velasco, Andres and Vincenzo Guzzo (1999). "The Case for a Populist Central Banker", *European Economic Review*, 43(7), 1317-1344


AUSTRIA
10
8
6
4
2
0
71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


DENMARK
16
14
12
10
8
6
4
2
0
71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


FRANCE
16
14
12
10
8
6
4
2
0
71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


GERMANY (WEST)
10
8
6
4
2
0
71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


ITALY
25
20
15
10
5
0
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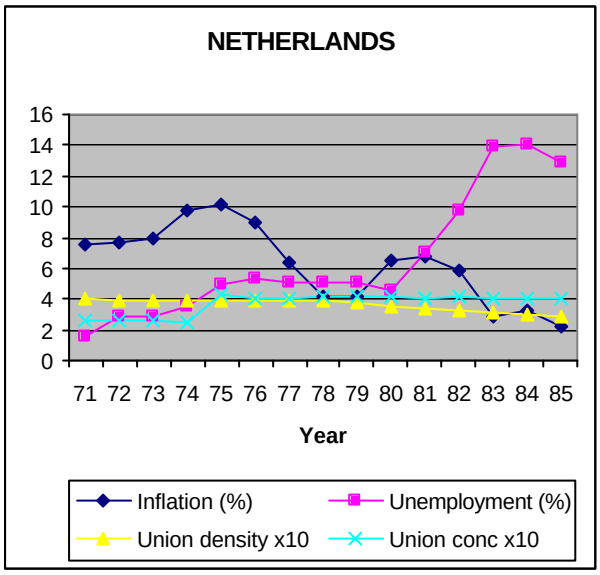
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


NETHERLANDS
16
14
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2
0
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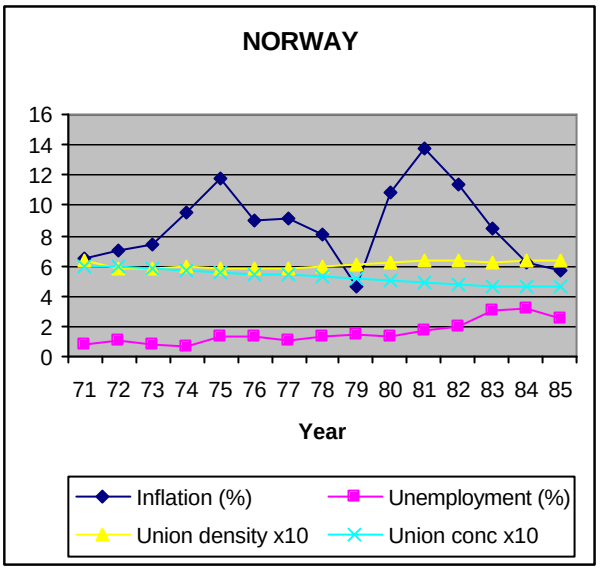
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


NORWAY
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14
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6
4
2
0
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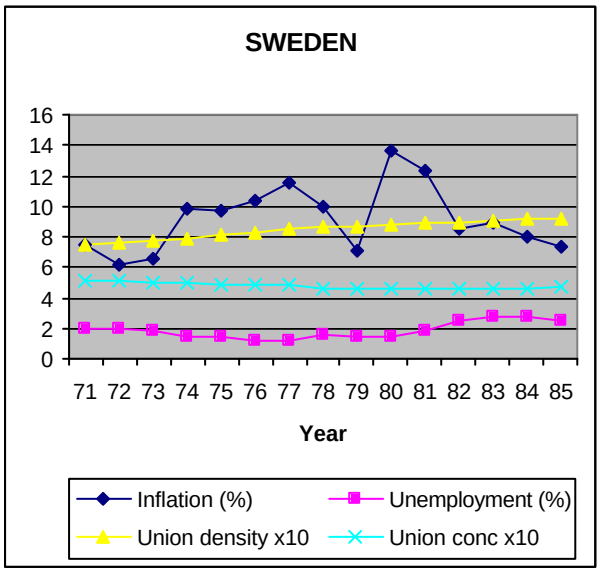
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


SWEDEN
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2
0
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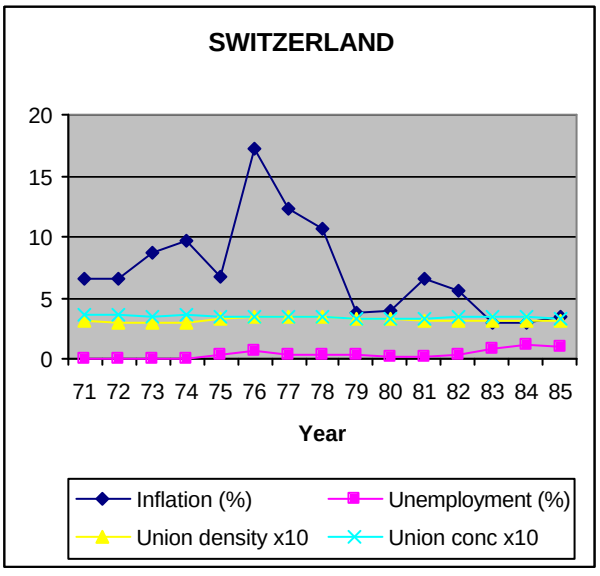
Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10


SWITZERLAND
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15
10
5
0
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Year
Inflation (%)
Unemployment (%)
Union density x10
Union conc x10