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The political economy of inflation: Bargaining structure or central bank independence? *

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Abstract. The causes of inflation are commonly analyzed as the function of either the organization of wage bargaining or the independence of the central bank. Although these explanations are widely treated as competing, recent evidence suggests that there may be merit to both arguments. This paper presents a game-theoretic model of wage bargaining and monetary policy-making that shows why the two institutional causes are not only complementary, but elements of a more encompassing logic. The empirical superiority of this synthesizing model is demonstrated by reanalyzing data used in Al-Marhubi and Willett (1995) and by presenting new evidence.

1. Introduction

Following the oil price shock in 1973, governments in many OECD countries introduced incomes policies as a means to control prices and improve the trade-off between inflation and unemployment. According to a large literature on neo-corporatism, such policies were particularly successful where they were coupled with centrally organized wage bargaining institutions capable of enforcing negotiated wage restraint. In the 1980s, however, government policies and economic theory turned away from the focus on wages to a focus on the supply of money. From the monetarist perspective, the price-wage behavior of private economic agents was determined by these agents' expectations about monetary policies. Inflation was therefore ultimately a function of the policies followed by the monetary authority.

Recently, a debate has surfaced about the relative merits of these perspectives. Havrileski and Granato (1993) have argued that while the neo-corporatist argument is plausible, the empirical record shows that independ-

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ent and inflation-adverse central banks are far more important than corporatist bargaining structures for producing low inflation. In response to these findings, Al-Marhubi and Willett (1995) have suggested that the statistical test used by Havrileski and Granato may be biased against finding effects of bargaining structure. They argue, following Calmfors and Driffill (1988), that instead of using a linear formulation of the relationship between centralization and inflation, a curvilinear model (where intermediately centralized systems are the most inflationary) is more suitable to testing a sophisticated version of the neo-corporatist thesis. By using this hump-shaped formulation, they find that centralization of bargaining does appear to matter for inflation, although central bank independence continues to be the more important factor.

The studies by Havrileski and Granato (1993) and by Al-Marhubi and Willett (1995) are important because they engage two literatures which seek to explain a similar phenomena (inflation), yet reach very different conclusions.¹ However, neither study directly examines the theoretical linkages between wage setting and monetary policy. Indeed, they treat the arguments about the role of central bank independence and bargaining structure as separate or even competent explanations. This paper, by contrast, argues that the two perspectives are part of a single and more encompassing logic, and that the two literatures *need* each other in order to provide a satisfactory explanation of inflation.

Specifically, the paper presents a game-theoretic model that combines a Calmfors-Driffill perspective on wage setting with a standard Barro-Gordon model of monetary policy making. In this synthesizing model, unions and monetary authorities are mutually influencing each others choices and welfare, subject to the constraints defined by the institutional structure. The model shows that centralization of bargaining affects inflation outcomes, but that the effect is conditional on the conservatism of the monetary authority. The model produces empirical hypotheses that differ from not only those derived from the “pure” models, but also from those that are implied by mixed or additive models. By reanalyzing the data in Al-Marhubi and Willett (1995), and by presenting new evidence for a substantially larger data set, I show that these hypotheses are much better supported by the data. In the conclusion, I draw some implications for institutional design.

2. The model

As in Al-Marhubi and Willett (1995) I use the formulation of the bargaining structure argument proposed by Calmfors and Driffill (1988). However, unlike Calmfors and Driffill, I do not treat prices as a function of union-

determined wages, but instead introduce a monetary authority that sets prices *in response to* union wage behavior. This monetary authority behaves as in a standard Barro-Gordon (1983) model, and all the results are consistent with a rational expectations framework.

The presentation of the model is divided into three sections. The first defines the welfare functions of unions and the monetary authority. The second presents the basic game played between unions and the monetary authority, while the third discusses some extensions of the model.

2.1. *Utility functions*

Similar to Calmfors and Driffill (1988), unions determine wages subject to the constraint that such choices affect unemployment among their members. The preferences of any union i is given by the following objective function:

$$W_i(w_i, U_i) = \alpha(w_i - \pi) - (1 - \alpha)U_i^2 \quad (1)$$

where w_i is the percentage nominal wage increase, π is the percentage increase in consumer prices, and U_i is the unemployment rate among union i 's members. The equation says that welfare is increase with real wages ($w_i - \pi$), but falling with unemployment. Note that the marginal disutility of unemployment is increasing with the level of unemployment, so that the more members are unemployed the more costly it will be for any unemployed member to find a new job.²

The employment and inflation consequences of wage-price pressure depend on the degree to which such pressure is accommodated through monetary expansion. Ultimately, the inflation rate is assumed to be determined by the monetary authority. However, the monetary authority chooses this rate subject to the constraint that its choices will affect the rate of unemployment. Specifically, the welfare function (W_m) for the monetary authority is defined as

$$W_m(\pi, \bar{U}) = -\iota\pi^2 - (1 - \iota)\bar{U}^2 \quad (2)$$

where π is the inflation rate, U_a is the average unemployment rate, and $\iota = [0,1]$ is the weight that the monetary authority places on price stability (its "conservatism").

2.2. *The game*

As illustrated in Figure 1, the structure of the game played between unions and the monetary authority can be analytically divided into a *horizontal game* between unions where each simultaneously choose a wage strategy, and a

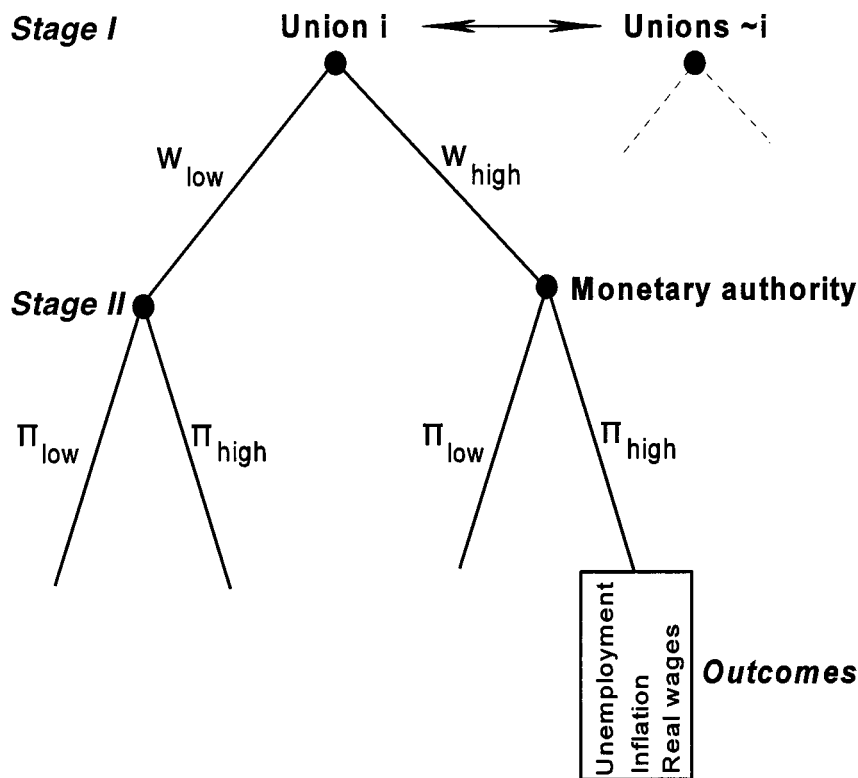


Figure 1. Structure of the game.

vertical game where unions first choose a nominal wage rate (stage I) after which the monetary authority decides on an inflation rate (stage II).³ The horizontal game corresponds to the Calmfors-Driffil setup, while the vertical game corresponds to a Barro-Gordon setup (except that wages are set by unions instead of by firms). Technically, this is a game of complete but imperfect information since preferences are common knowledge, while decisions over wages are made simultaneously. Because unions know the objective function of the monetary authority, they will rationally take into account the effect of their own behavior on the price behavior of the monetary authority.

When modeling the impact of wages on prices, it is necessary to distinguish between a relative and an aggregate effect. The size of the relative effect depends on the capacity of firms within a particular collective bargaining area to externalize wage increases through price increases. Assuming (with Calmfors and Driffil) that unions amalgamate within sectors producing close substitutes, and that such amalgamation takes place between pairs of unions of equal size, the capacity to externalize wage costs is positively related to the

level of centralization since the price elasticity of product demand declines the more firms are subjected to the same wage rate. The relative price effect can therefore be expressed as

$$\pi_i^r = cw_i, \quad (3)$$

where $c = 1/n$ measures the degree of centralization (n representing the number of unions).⁴ If the number of unions is very large, c will approximate zero and unions will face nearly perfectly competitive product markets with no possibility for price externalization. By contrast, if there is a single encompassing union then c equals one, and all wage increases will be reflected in higher prices. Since unions are equally sized, if the average wage increase in any other bargaining area is denoted w_o , when the relative price effect in any of these other bargaining areas (π_o^r) is similarly

$$\pi_o^r = cw_o. \quad (4)$$

The *aggregate* price effect of a wage increase in any single bargaining area is obviously smaller than the relative price effect since the latter only applies to the segment of the market covered by that bargaining area. Assuming that aggregate price increases are accommodated by the monetary authority, i.e., matched by the chosen rate of inflation, the expected aggregate effect for union i is a proportion of the relative effect where the weight is relative to the degree of centralization (which also measures the size of a single bargaining area):⁵

$$\pi_i^a = ccw_i = c^2w_i. \quad (5)$$

Similarly, expected aggregate price effects of wage increases in other bargaining areas are proportional to the share of the labor market covered by unions in those bargaining areas:

$$\pi_o^a = (1 - c)cw_o. \quad (6)$$

If the monetary authority does *not* accommodate the aggregate wage increase (by choosing a rate of inflation that is lower), real wages will be rising, profits will be squeezed and layoffs and growing unemployment will ensue. In this case, the aggregate price effects will not be realized. Equation (5) and (6) therefore represent conditional or implied aggregate price effects that may or may not exceed the actual inflation rate. Analogously, any wage increase within a bargaining area that is above the rate of relative price increases will cause a reduction in profits, and a subsequent increase in unemployment.

Assuming, for simplicity, a point-by-point relationship between real wages and unemployment, the change in unemployment among the members

of union i can now be written as a simple additive function of the difference between the implied and actual rate of inflation (the first bracketed term) plus the difference between the union-specific wage increase and the relative price effect (the second bracketed term):

$$\Delta U_i = [\pi_i^a + \pi_o^a - \pi] + [w_i - \pi_i^r]. \quad (7)$$

The first term captures the aggregate demand effect of the monetary policy, while the second term captures the effect of higher relative wages.

Substituting the expressions for π_i^a , π_o^a , π_i^r into (7) and collecting terms yield

$$\Delta U_i = w_i(c^2 - c + 1) + w_o c(1 - c) - \pi. \quad (8)$$

Analogously, the increase in *aggregate* unemployment is the following weighted average:

$$\Delta \bar{U} = [\pi_i^a + \pi_o^a - \pi] + c[w_i - \pi_i^r] + (1 - c)[w_o - \pi_o^r]. \quad (9)$$

which (substituting in the values for π_i^a , π_o^a , π_i^r , π_o^r) is equivalent to

$$\Delta \bar{U} = cw_i + (1 - c)w_o - \pi. \quad (10)$$

It is now possible to solve the game. We first compute the optimal inflation rate that the monetary authority chooses in the second stage of the game. This maximization problem is given by

$$\text{Max} W_m(\pi, \bar{U}) = -\iota\pi^2 - (1 - \iota)(\bar{U} + \Delta \bar{U})^2, \quad (11)$$

and in order to find the optimal inflation rate (π^*), we substitute the expression for $\Delta \bar{U}$ (Equation 10) into (11) and set the partial derivative with respect to π equal to zero:

$$\frac{\delta W_m}{\delta \pi} = \frac{\delta[-\iota\pi^2 - (1 - \iota)(\bar{U} + cw_i + (1 - c)w_o - \pi)^2]}{\delta \pi} = 0 \quad (12)$$

We can now solve for π :

$$\pi^*(w_i) = (1 - \iota)[\bar{U} + cw_i + (1 - c)w_o]. \quad (13)$$

The result shows that the inflation rate chosen by the monetary authority is decreasing in ι but increasing in w_i . In other words, inflation will depend not only on how much the monetary authority values low inflation, but also on the militancy of unions.

The next question is what wage increase unions will demand given that they anticipate the monetary authority will choose an inflation rate of $\pi^*(w_i)$.⁶ We find this by solving union i 's maximization problem in the first stage of the game:

$$\text{Max} W_i(w_i - \pi^*, U_i) = \alpha(w_i - \pi^*)(U_i + \Delta U_i)^2. \quad (14)$$

Substituting the expressions for π^* (Equation 13) and ΔU_i (Equation 8) into Equation (14), and setting the partial derivative equal to zero, we can solve for w_i :

$$w_i^*(\pi^*) = \frac{\alpha(1-c+cl) - 2(1-\alpha)w_o(c^2 - 2c + cl + 1)(2c - c^2 - 1 + l - cl)}{2(1-\alpha)(c^2 - 2c + cl + 1)^2} - \frac{2(1-\alpha)l\bar{U}(c^2 - 2c + cl + 1)}{2(1-\alpha)(c^2 - 2c + cl + 1)^2}. \quad (15)$$

In fact, this expression can be greatly simplified since in equilibrium it must be that case that all unions behave identically ($w_i = w_o$):

$$w_i^*(\pi^*) = \frac{\alpha(1 - c + cl) - 2(1 - \alpha)l\bar{U}(c^2 - 2c + cl + 1)}{2l(1 - \alpha)(c^2 - 2c + cl + 1)^2} \quad (16)$$

Similarly, the optimal inflation rate for the monetary authority when unions behave identically is

$$\pi^*(w_i^*) = (1 - l)(U + w_i^*). \quad (17)$$

Inserting (16) into (17) gives us the final expression for the equilibrium rate of inflation chosen by the monetary authority given that unions choose their optimal wage ($\pi^*(w_i^*)$):

$$\pi^*(w_i^*) = \frac{\alpha(1 - l)(1 - c + cl)}{2l(1 - \alpha)(c^2 - 2c + cl + 1)}. \quad (18)$$

Note that inflation is unambiguously falling in l , but that the effect of centralization is more complex. As it turns out, the relationship is hump-shaped as predicted by Calmfors and Driffill, but the size of the "hump" depends on the conservatism of the monetary authority, i.e., the weight it places on controlling inflation as opposed to reducing unemployment (see Figure 2). Even with a monetary authority that can sovereignly determine the inflation rate, and with rational expectations on the part of unions, the structure of the bargaining system clearly matters for inflation outcomes. The reason is that for all $l < 1$, the monetary authority will let unemployment affect its decisions, and the wage behavior of unions influences the level of unemployment. In order to explain inflation performance we thus need to consider both the preferences of the monetary authority and the structure of the bargaining system.

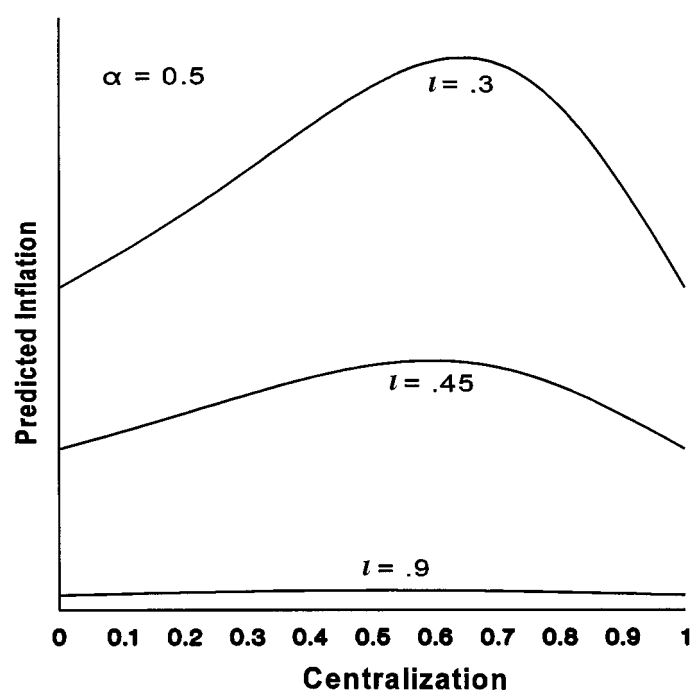


Figure 2. The predicted effect of centralization on inflation for different levels of monetary conservatism.

Moreover, the model implies that it is *not* sufficient to explain inflation by simply combining the centralization logic and the central bank independence logic in an additive model. The two variables *interact*.

2.3. Extensions

There are three potential extensions to the model that need to be pointed out. The *first* concerns the effects of uncertainty and the ease by which wage contracts can be renegotiated. If price- and wage-setters are uncertain about the monetary authority's "type" – i.e., whether it is anti-inflationary or not – ex ante inflation expectations may not be fulfilled ex post. This gives "soft" monetary authorities a short-term incentive to inflate as explained in Alesina, Cohen, and Roubini (1992). However, if it is easy to alter wage contracts in response to unanticipated monetary policies, the monetary authority cannot produce any short-term employment effects. By the same token, since employment effects are negligible, it would no longer be very costly for the monetary authority to establish a reputation for "toughness" in order to reduce inflation – quite irrespective its true type. Under these circumstances it would make little difference for outcomes if a non-accommodating policy rule was

institutionalized or not. All monetary policy-makers, regardless of their true type, would converge to the same anti-inflationary policy.⁷

However, type is important when there are costs associated with developing a reputation for toughness, and such costs can be considerable in terms of unemployment when wages and prices are difficult to alter in the short run. With sticky wages and prices, only the “tough” type would carry out a threat not to accommodate, and type would again become important as implied by the complete information model.⁸ This contingent role of policy type is important because the degree of wage flexibility is dependent on the character of the bargaining system. *Ceteris paribus*, decentralized market-based systems tend to be more flexible in the short run than intermediately centralized and centralized systems (where wage contracts are typically negotiated synchronously for one or two year periods). We would therefore predict the monetary authority’s type to be less salient for inflation outcomes in completely decentralized systems than in more centralized ones.

The *second* qualification concerns centralized bargaining systems and the role of solidaristic wage policies. As unions representing increasingly dispersed wage groups are confederated, unions with low paid members will try to use their intra-organizational bargaining power to demand wage increases based on a flat rate principle rather than on a proportionality principle. Because such wage solidarity tends to be undermined by wage drift – a common phenomenon in all collective bargaining systems – centralized bargaining system has a built-in incentive for the union confederation to try to “compensate” for the inequalizing effects of anticipated wage drift by demanding higher bargained increases (which follow a solidarity principle) (see Hibbs and Locking, 1996; and Iversen, 1996a).⁹ The implication is that inflation falls less rapidly with centralization when the monetary authority is accommodating, and it may cause an upward “bend” on the curve when the monetary authority is conservative.

Thirdly, wage militancy in decentralized systems may be a greater problem than anticipated by the basic Calmfors-Driffill model as a result of “jealousy” effects between different wage groups, or as a result of externalities from unemployment. For example, Layard, Nickell, and Jackman (1991: 130) have argued that “in firm-level bargaining the bargainers take the general level of unemployment as given – ignoring the fact that their own actions will affect the jobs open to other workers.” Another externality results because workers have to contribute to the financing of unemployment benefits regardless of their wage behavior. To the extent that these externalities are important, decentralized bargaining will be more inflationary than predicted. With a conservative monetary authority this could mean that inflation is actually falling as we go from decentralized to intermediately centralized systems

(because some externalities are being internalized). In combination with the argument about solidaristic wage policies, the implication is that the hump-shaped relationship between centralization and inflation will not only “flatten out” as the monetary authority becomes more restrictive (as illustrated in Figure 2), but actually turn into a U-shaped relationship. Whether or not this is the case is a matter for empirical analysis, to which I now turn.

3. Data and statistical models

It has been widely argued that the preferences of monetary authorities are closely linked to the institutional setup of the central bank; especially the extent to which a conservative inflation-adverse central bank is capable of pursuing monetary policies independent from democratically elected governments (see, e.g., Kydland and Prescott, 1977; Cukierman and Meltzer, 1986; Grilli, Masciandoro, and Tabellini, 1991; and Alesina and Summers, 1993). The idea is that governments facing competition in electoral markets can ill afford not to be concerned with unemployment, whereas independent central banks are more prone to, and capable of, embracing an anti-inflationary agenda. Central bank independence is therefore a reasonable proxy for the model parameter ι which measures the conservatism of the monetary authority (the relative weight placed on fighting inflation as opposed to unemployment). This is also the approach adopted by Al-Marhubi and Willett (1995) who test the effect of four different indexes of central bank independence developed by Grilli et al. (1991), Cukierman, Webb, and Neyapti (1992), Burdekin and Willett (1991) and Alesina (1988).

With respect to bargaining structure, Al-Marhubi and Willett rely on Calmfors and Driffill’s re-scaling of Cameron’s index for the degree of corporatist bargaining. In order to test the possible hump-shaped relationship between centralization and inflation, the index is constructed so that both highly centralized and very decentralized systems have low scores, while intermediately centralized systems have high scores. I also employ Cameron’s index, but because it is static and contains some controversial classifications, I extend the analysis to a recent time-dependent index of centralization presented in Iversen (1996a; 1997).

Al-Marhubi and Willett combine the central bank independence indexes with the measure of bargaining structure in an additive statistical model that is applied to 13 OECD countries in the period 1973–1989. The model has the following form:

$$\text{Inflation} = a + b_1 \text{cbi} + b_2 \text{barg} + b_i \text{control}_i + e \quad (19)$$

where *cbi* is the index measuring central bank independence and *barg* is the index measuring the structure of the bargaining system. They also include control variables for economic openness, the level of government deficit spending, and the degree to which the value of a country's currency is fixed – all factors that can reasonably be expected to influence national inflation rates.

If any of the pure models of inflation are true, then *either* b_1 will be negative and significant, *or* b_2 will be positive and significant. If there is merit to both the central bank independence argument and the bargaining structure argument, both variables would have significant coefficients in the predicted directions. However, this formulation is a poor specification of the interactive model presented in this paper, and it may not capture the full effects of the institutional variables. A more direct test of the strategic interaction argument would imply the following model:

$$\begin{aligned} \text{Inflation} &= a + b_1 \text{cbi} + b_2(\beta - \text{cbi}) * \text{barg} + b_3 \text{control}_i + e \\ &= a + b_1 \text{cbi} + b_2 \beta * \text{barg} - b_2 \text{cbi} * \text{barg} + b_3 \text{control}_i + e \end{aligned} \quad (20)$$

where β is some positive number that depends on the scale of the *cbi* index and the particular form of the interaction between central bank independence and bargaining structure. The basic idea is that when central bank independence increases, the deleterious inflation effects of intermediately centralized bargaining systems (the hump) decreases. The parameter β can be easily inferred by estimating the model specified in the second line of (20).¹⁰ Knowing β permits the model in the first line to be estimated while saving one degree of freedom.

Yet, the specification in (20) is still too restrictive because it assumes not only that the peak of the hump is at the center of the centralization scale, but also that the inflation performance of centralized and decentralized systems is exactly the same for any given level of central bank independence. As discussed above, the effects of solidaristic wage policies, decentralized wage competition, and uncertainty make these assumptions questionable. Instead, I use a model that permits inflation to vary between centralized and decentralized systems, and leaves the location of the peak of the hump unrestricted:

$$\begin{aligned} \text{Inflation} &= \\ &a + b_1 \text{cbi} + b_2(\beta - \text{cbi}) * \text{cen} + b_3(\beta - \text{cbi}) * \text{cen}^2 + b_4 \text{control}_i + e, \end{aligned} \quad (21)$$

where *cen* is the unmodified centralization index. In this formulation, b_2 is expected to be positive, while b_3 is expected to be negative (i.e., inflation first rises and then falls with centralization).

In the following section the different hypotheses will be tested by i) reanalyzing the Al-Marhubi and Willett data, ii) applying the models to a larger sample which includes all the countries originally classified by Cameron, and iii) extending the test to a new and much larger longitudinal data set containing a total of 90 observations.

4. Findings

The first three columns of Table 1 reproduce the results presented in Al-Marhubi and Willett (1995) for three of the four central bank indexes they use.¹¹ The only difference is that I have reversed the Cukierman et al. index so that it measures central bank independence (rather than dependence), making it consistent with the other indexes.

Note that the effect of central bank independence is always strong and statistically significant in the predicted direction. The results for the bargaining structure variable are weaker, but also statistically significant. Among the control variables, economic openness seems to have a dampening effect on inflation, while there appears to be slightly inflationary effects of budget deficits. Exchange rate pegging does not have any discernable effects.

Al-Marhubi and Willett also use an index of central bank independence proposed by Alesina (1988), but in this case they find no effect of bargaining structure. This result could be due to a peculiarity of the Alesina index – which is based on one of the first and most impressionistic measures of central bank independence by Bade and Parkin (1982) – but it could also be due to the fact that the index includes two highly centralized bargaining systems (Norway and Sweden) that are missing from the test of the other models. If the latter is true, it would cast serious doubt on the general applicability of the bargaining structure argument.

Fortunately, there is a way to test this. Al-Marhubi and Willett use only 13 of the 16 countries originally coded by Cameron, and the three excluded countries (Finland, Norway and Sweden) all have highly centralized bargaining systems (in the period under investigation). Since all countries are coded by at least one of the three central bank independence indexes, it is possible to create a composite cbi index that can be applied to all 16 cases (see column 4 of Table 1).¹² Note that the results for this composite index are very similar to the other models, suggesting that the effect of bargaining structure is *not* peculiar to the particular choice of cases. However, the results for the bargaining variable are clearly weaker overall than the results for the central bank independence variable.¹³ So while bargaining structure *does* seem to matter, one could be justified in concluding that it does not matter much compared to central bank independence.

Table 1. Dependent variable: Average annual inflation (1973–1989)

Variable	1	2	3	4
Constant	11.82 (3.50)**	15.15 (3.00)**	6.96 (3.79)**	9.96 (5.88)**
Openness	-0.10 (1.81)*	-0.15 (2.37)*	-0.10 (1.93)*	0.11 (2.03)*
Budget Deficit	0.31 (1.23)	0.29 (1.08)	0.42 (2.00)*	0.09 (0.47)
Grilli et al. index	-0.67 (2.34)*			
Cukierman et al. index		-182.25 (2.13)*		
Willett's index			-3.92 (2.67)*	
Composite index				-7.06 (4.08)*
Degree of exchange fixity	-0.16 (0.07)	2.40 (0.92)	0.28 (0.14)	1.97 (1.03)
Bargaining structure	0.32 (2.28)*	0.37 (2.45)*	0.29 (2.23)*	0.24 (1.93)*
Adjusted-R ²	0.54	0.50	0.60	0.53
N	13	13	13	16

Sources: *International Financial Statistics*, International Monetary Fund (for Finland); Al-Marhubi and Willett (1995), Calmfors and Driffill (1988); Cukierman et al. (1992); Grilli et al. (1991).

*Significant at the .10 level.

**Significant at the .01 level.

Such a conclusion, however, does not stand up to the evidence for the interactive model which is shown in Table 2 (column 1–4). Here all the parameters for the institutional interaction terms are in the predicted direction and statistically significant at a .01 level or better, whereas the *cbi* variable does not have any significant independent effect. Because the lowest value on the Cameron centralization index has been set to zero, this implies that the effect of central bank independence is very small for completely decentralized bargaining systems. Recalling the possible role played by uncertainty and short-term wage flexibility in decentralized systems, this result is not too surprising. Yet, it does suggest that the free market assumption in most models of monetary policy (including the Barro-Gordon model) is extremely restrictive.

Table 2. Dependent variable: Average annual inflation (column 1–4: 1973–1989; column 5: 1973–1995)

Variable	1	2	3	4	5
Constant	5.60 (2.17)*	10.68 (2.81)*	5.51 (3.88)**	8.27 (5.57)**	0.21 (0.20)
Openness	-0.09 (2.11)*	-0.17 (2.75)*	-0.05 (1.05)	-0.15 (3.40)**	-0.06 (3.38)**
Budget deficit	0.13 (0.85)	0.11 (0.20)	0.31 (2.08)*	0.13 (0.79)	0.17 (2.12)*
Grilli et al. index	0.14 (0.59)				
Cukierman et al. index		-77.77 (1.27)			
Willett's index			-0.52 (0.32)		
Composite index				-1.13 (0.58)	-0.83 (0.76)
Degree of exchange fixity	0.90 (0.64)	3.74 (1.82)	0.58 (0.39)	1.80 (1.09)	4.80 (3.50)**
(β -cbi index)* centralization	0.39 (5.09)**	59.94 (4.24)**	1.86 (4.16)**	1.67 (3.50)**	44.39 (2.88)**
(β -cbi index)* centralization ²	-0.03 (4.49)**	-4.13 (3.54)**	-0.15 (3.73)**	-0.09 (2.94)**	-111.16 (2.85)**
Lagged dependent variable					0.16 (1.89)
Average inflation across countries					1.04 (10.66)**
Adjusted-R ²	0.83	0.73	0.79	0.71	0.77
N	13	13	13	16	90
β	11.6	0.08	0.96	0.91	0.51

Sources: *International Financial Statistics*, International Monetary Fund (for Finland); Al-Marhubi and Willett (1995), Calmfors and Driffill (1988); Cukierman et al. (1992); Grilli et al. (1991).

*Significant at the .10 level.

**Significant at the .01 level.

The more important implication of the findings, however, is that the effect of central bank independence and centralization of bargaining on inflation can only be fully appreciated as a result of their conjunctural causation. Compared to the simple additive model, the findings for the interactive model implies a substantial improvement in explanatory power. Thus, the adjusted R-square increases from between 19% (in the case of the Willett index) and 29% (in the case of the Grilli et al. index).

Figure 3 graphically depicts the interaction between monetary and bargaining institutions by mapping the estimated level of inflation for different

levels of centralization when the central bank is either dependent or independent (measured as one standard deviation below and above the mean, respectively). The results are revealing. As predicted by the basic game-theoretic model, all four formulations conform to a hump-shaped relationship between centralization and inflation, where the size of the hump is reduced by higher degrees of central bank independence. It is also in accordance with the basic interactive model that central bank independence has its greatest effect in intermediately centralized systems. Note however that centralized systems are relatively more inflationary than expected from the basic model. This is particularly evident in the results for the composite cbi index (panel d) which includes the highly centralized Nordic countries where solidaristic wage policies have played a particularly important role (Rowthorn, 1992; Iversen, 1996b).¹⁴ This finding therefore supports the notion that solidaristic wage policies have inflationary consequences, although the relationship between centralization and inflation for most values of central bank independence continues to be hump-shaped as predicted by the basic model.¹⁵

The effects of wage solidarism and decentralized wage competition comes out more clearly when the interactive model is applied to a larger sample containing 15 countries and six time periods from 1973 to 1995 (column 5 of Table 2).¹⁶ The variables in this test are measured similarly as before *except* for the centralization index which has been adopted (and updated) from Iversen (1996a, 1997).¹⁷ The variable measuring degree of exchange rate fixity is an index ranging from 0 to 1 (as before) based on the square of the rate of growth in the nominal effective exchange rate, with higher values implying that the exchange rate is closer to being invariant or fixed.¹⁸ The statistical model has also been adjusted to take account of the pooled time-series nature of the data, including a lagged dependent variable to eliminate serial correlation, and a variable measuring the average rate of inflation in each period to eliminate international “contagion” effects.¹⁹

Unlike the previous results, the hump-shaped relationship for this model is not merely dampened by increasing central bank independence, but actually reverses into a (mild) U-shape as central bank independence increases (see Figure 4). Although central bank independence always reduces inflation (but, again, not very much for decentralized systems), it has a considerably greater effect when bargaining is intermediately centralized than when it is either centralized or decentralized. These results support the notion that distributive compromises within a confederal union structure are inflationary (cf. Hibbs and Locking, 1996; Iversen, 1997), and they echo the findings in Havrilevski and Granato (1993) which show that centralized systems do not offer effective brakes on inflation. On the other hand, the results also challenge the notion that decentralized bargaining is necessarily an effective means to control in-

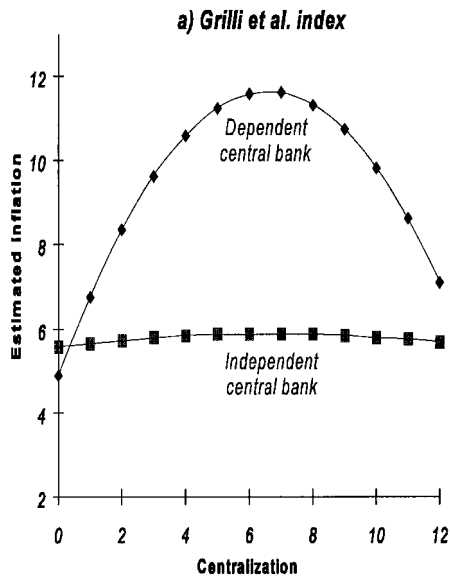


Figure 3a.

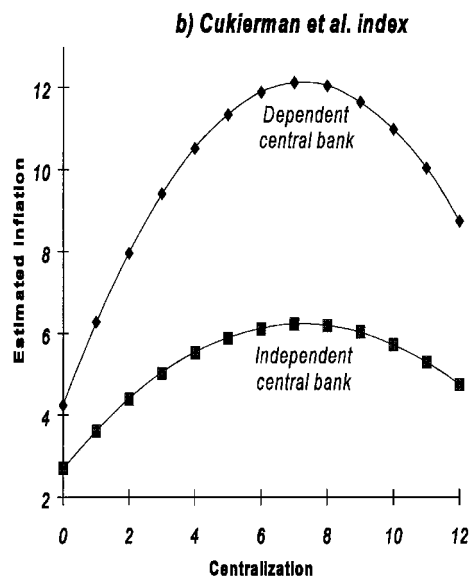


Figure 3b.

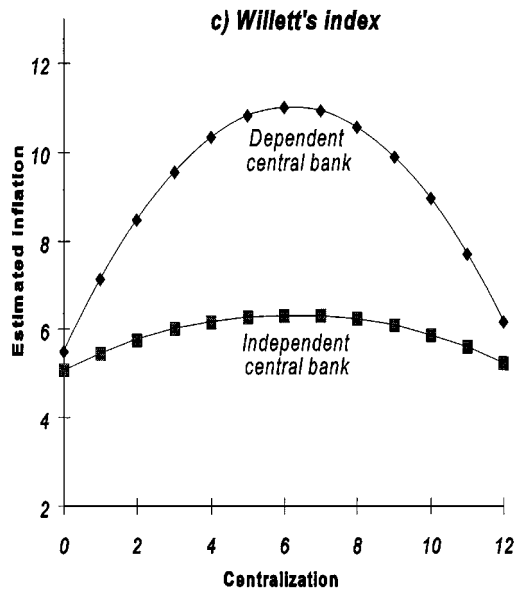


Figure 3c.

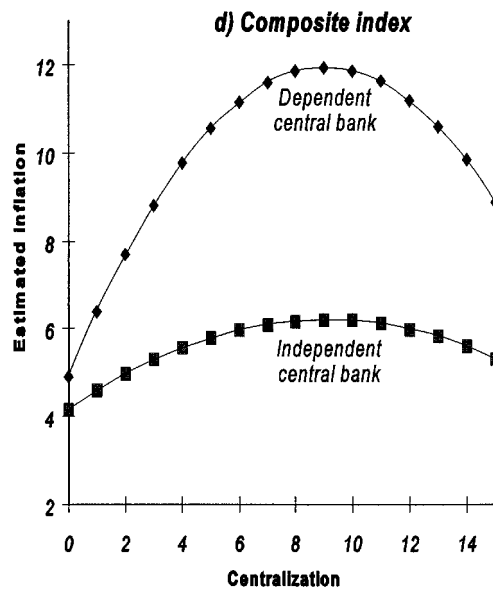


Figure 3d.

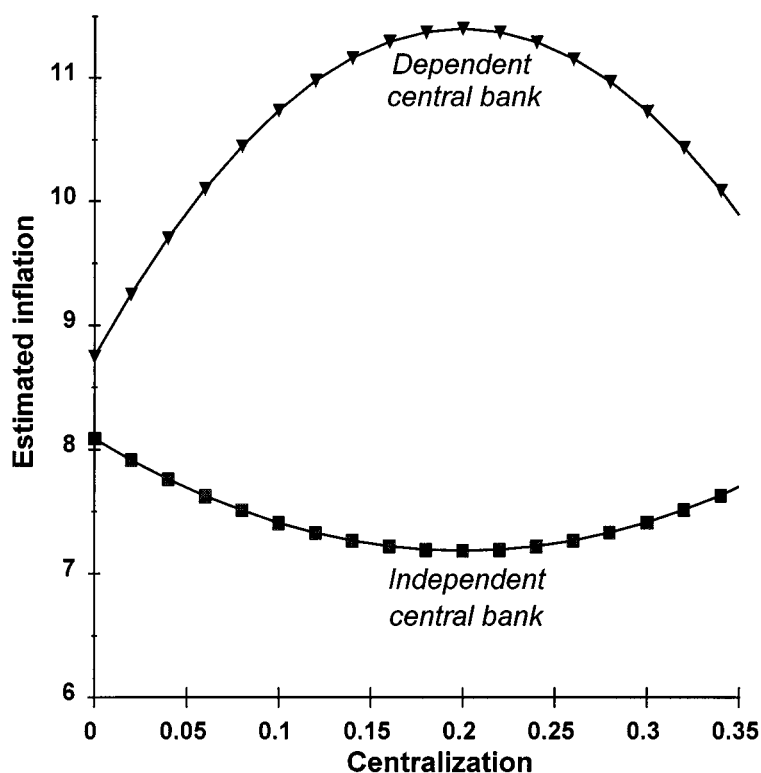


Figure 4.

flation. Instead they point to the possibility that intermediately centralized systems may actually outperform all others if combined with an independent central bank. In terms of the theoretical argument, the reason is that unions in intermediately centralized systems can be deterred from engaging in militant behavior (unlike unions in decentralized systems), at the same time as inflationary wage solidarism is kept at a modest level (unlike in centralized systems). This helps to explain why some of the institutionally most stable systems (e.g., Austria, Germany and Switzerland) are found in the intermediately centralized category where we would *not* have expected them from a basic Calmfors-Driffill perspective.

The differences in the results for the pooled cross-sectional time-series analysis and the simple cross-sectional models may come from several sources, including the obvious fact that the former tracks changes over time while the latter do not. However, much of the difference can probably be attributed to differences in the measurement of bargaining centralization. Although the Iversen index is highly correlated with Calmfors and Driffill's application of the Cameron corporatism index ($r=.87$), important cases such

as Austria and Japan are coded slightly differently (especially when taking the ratio-scale character of the index into account). In the case of Austria the index reflects the fact that wage bargaining in this country is not occurring at the peak level, as implied by the Cameron index, but only at the industry and firm levels (see Golden and Wallerstein, 1995). Conversely, the classification of Japan, unlike the Cameron index, acknowledges that considerable bargaining power is vested at the national peak level (Soskice, 1990; Shirai, 1987). These differences notwithstanding, the results all agree that the relationship between centralization and inflation is contingent on the monetary regime, and that central bank independence has a particularly strong anti-inflationary effect in intermediately centralized systems.

5. Conclusion

The debate about the relative salience of central bank independence versus wage bargaining structure for inflation has initiated an important dialogue between two prominent bodies of political economy literature, but the theory of how wage bargaining institutions and monetary policy regimes are causally linked to each other, and to inflation, remains underdeveloped. This paper has presented a theoretical model that seeks to clarify these causal links. The model underscores the importance of conceptualizing inflation as a result of a strategic interaction between wage negotiators and central bankers, and it emphasizes that central bank independence and wage bargaining are mutually conditioning each institution's effect on inflation.

The empirical results strongly support the need for such a synthesis, with the interactive model producing a much better approximation to the empirical record than any simple additive model. In particular, the inflation-reducing effect of central bank independence is much greater for intermediately centralized systems than for either of the extreme systems. To the extent that there are off-setting political and/or economic benefits from having politically controlled monetary policies, countries with extreme values on the centralization scale can therefore better "afford" to have dependent banks. This is particularly clear in decentralized systems where the monetary regime seems to matter little for inflation, but it also applies to centralized systems because the unemployment costs of central bank independence are greater here (due to nominal wage rigidities). This proposition is supported by the empirical pattern of central bank independence which is high for intermediately centralized cases ($cbi=.49$), but low for both decentralized ($cbi=.28$) and centralized systems ($cbi=.23$).

Whatever the exact causal mechanisms behind this pattern, it is clear that governments must pay equal attention to the organization of wage setting

and the constitution of the central bank when formulating effective inflation strategies. For example, if the government is set on maintaining its discretion over monetary policies, it must promote either centralization or decentralization of bargaining in order to contain inflationary pressures (though these “options” are not distributively neutral). On the other hand, if the government is willing to accept institutional constraints on its monetary policy autonomy, industry-based bargaining systems are entirely compatible with good inflation performance (in fact, they may be better than any other system). This lesson is particularly pertinent to countries (such as Sweden) that have recently been undergoing a process of decentralization of bargaining from the peak to the industry level.

Notes

1. For other studies of the relationship between wage bargaining, central bank independence, and economic performance see Soskice (1990), Scharpf (1991), Hall (1994), Franzese (1996) and Iversen (1996a). All of this work has been a great source of inspiration for the argument made in this paper.
2. Alternatively, one could argue that the marginal utility of wage increases is declining with the size of such increases, but the substantive results would be unaffected.
3. Technically, however, there is only one game that has to be solved since unions are choosing their strategies simultaneously and in anticipation of the reaction of the monetary authority.
4. One could argue for other functional relationships (such as $\pi^r=c^2$), but it would not affect the substantive results.
5. To see this note that when the relative price effect is π^r_i , the aggregate price effect is simple the sum of all relative price increases divided by the number of bargaining areas: $1/n \sum \pi^r_i$, which is equivalent to $c\pi^r_i + (1-c)\pi^r_o = cw_i$ the aggregate effect can be written as $c^2w_i + (1-c)\pi^r_o$. The marginal effect on the aggregate price level of a wage increase by union i is then $\delta\pi/\delta w_i = c^2w_i + (1-c)\pi^r_o = c^2$.
6. Because inflation is fully anticipated, maximizing nominal wage increases is equivalent in this model to maximizing real wage increases (say, by using a CoL indexation scheme).
7. In game-theoretic jargon this is called a pooling equilibrium.
8. In game-theoretic terms, this is a separating equilibrium.
9. See Iversen (1996a) for an elaboration of this argument, and how it can be formalized.
10. Specifically, β is found by dividing the parameter for the variable *barg* by the parameter for the interaction term *barg * cbi*. Alternatively it can be found by estimating the model in the first line of (20) for a range of β -values, and choosing the one that maximizes the fit of the model. I have used the latter method, but the two procedures generate very similar results.
11. While all the parameters are the same, the t-scores in Table 1 are lower than those reported by Al-Marhubi and Willett (1995, Table 3). The reasons for this discrepancy are not clear.
12. The three *cbi* indexes were first normalized to vary between 0 and 1, and then averaged. In the case of Finland, for which Al-Marhubi and Willett do not provide data, the figures for inflation and the various control variables were obtained from the same sources as quoted in Al-Marhubi and Willett.

13. For example, in the combined model a change in the value on the bargaining variable from one standard deviation below the mean to one standard deviation above the mean only raises inflation by about 2%, whereas a similar change in the *cbi* variable reduces inflation by about 6%.
14. The other results would underestimate inflation in highly centralized cases even more if one *projected* the level of inflation expected in the two cases (Sweden and Norway) that are more centralized than Austria (which is the most centralized system included in these tests).
15. For the highest levels of central bank independence, centralized systems are *more* inflationary than intermediately centralized systems.
16. The countries are: Austria, Belgium, Britain, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, and the United States. The time periods are 4 year intervals, except for one 3 year period (1993–95). The periodization was prompted by the high degree of temporal stability in the central bank independence index. While the underlying theoretical variable (the “conservatism” of the monetary authority) can be expected to converge to the index score over the medium run, it is reasonable to expect some fluctuation in the short run in response to temporary situational factors.
17. The index is a weighted average of the concentration of union membership at three levels of bargaining (the national, industry and firm levels), with weights reflecting the relative authority vested in each level (coded by bargaining round). In the hypothetical case where there is only one bargaining level, and all unions are the same size, the index would conform to the definition of centralization used in the theoretical section. In principle it can vary between 0 (all bargaining conducted by small company unions) and 1 (all bargaining conducted by a single monopoly union). In practice the index varies between .01 and 0.4. See Iversen (1996a) and (1997) for details.
18. Since governments can pursue stable exchange rate policies without official “pegs”, this seems to me to be a less arbitrary measure of exchange rate policies than simply coding countries as having pegged or un-pegged currencies (as do Al-Marhubi and Willett). As it turns out, the variable has a significant positive effect that is similar to effect of the Al-Marhubi and Willett index. The reason for this effect, however, is not clear (as also pointed out by Al-Marhubi and Willett).
19. The results are based on panel-robust standard errors, and the modeling approach is described in detail in Beck and Katz (1995).

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