

# 1 Theoretical Models

## 1.1 Banks and wage bargainers (Iversen 1999)

### 1.1.1 Background

Barro and Gordon: Time-inconsistency in monetary policy (no real effects)

Olson: Externalities and “encompassing” interest groups

Calmfors and Driffil: Hump-shaped relation between wage bargaining and unemployment

### 1.1.2 Play of the game and intuition

First unions set wages; then the monetary authority sets prices (as in Barro-Gordon). However, since unions have some market power, they set wages strategically to influence the central bank’s reaction. This results in real effects of monetary policy.

Iversen joins two literatures, central bank independence and corporatism. His basic intuition is that with an accommodating CB, Calmfors-Driffil’s unemployment ‘hump’ should still occur; if CWB is high or low, unions will be disciplined, but given moderate CWB, unions will use their market power to demand wage increases with subsequent unemployment. But a non-accommodating can enforce wage-restraint through a monetary policy threat anticipated by strategic unions. This ‘flips’ the Calmfors-Driffil curve (CBI “ups the ante” for moderately centralized unions, raising the private cost of wage militancy closer to the social cost).

### 1.1.3 Preference functions

Unions:

$$V_{U_i} = \alpha(w_i - \pi) - (1 - \alpha)U_i\bar{U} \quad (1)$$

Real wages:  $w_i - \pi$

Unemployment within union and economy:  $U_i\bar{U}$

(In Iversen's work, unions also care about wage inequality; I omit this here to simplify the model).

Monetary authority:

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

Price level:  $\pi$

Unemployment level:  $\bar{U}$

#### 1.1.4 Economic assumptions

Assume an economy with  $n$  equally sized unions, so that the centralization of the labor market can be denoted  $c = 1/n$ . Smaller  $n$  (higher  $c$ ) implies that unions have greater market power, conveying the ability to pass on wage increases through prices for union  $i$ 's good; call this a relative price effect. Iversen assumes that for any given union  $i$ , the relative price effect of wage demand  $w_i$  is  $\pi_i^r = cw_i$ . Analogously, for all other unions  $o$ ,  $\pi_o^r = cw_o$ . At the same time, there is an (smaller) aggregate price affect of wage increases in union  $i$  ( $o$ ), which Iversen assumes is given by  $\pi_i^a = c^2w_i$  ( $\pi_o^a = (1 - c)cw_i$ ).

We can use these four price effects to understand the incentives facing union  $i$  in wage bargaining, which depend on the effects of wage demands on unemployment. Specifically, we need to define the effects of wages on unemployment within the union and across the economy.

Iversen argues that unemployment would rise when either the aggregate price effect exceeds inflation, or when the wage rate in union  $i$  exceeds the relative price increase, hence:

$$\Delta U_i = (\pi_i^a + \pi_o^a - \pi) + (w_i - \pi_i^r). \quad (3)$$

Substituting,

$$\Delta U_i = w_i(c^2 - c + 1) + w_o c(1 - c) - \pi. \quad (4)$$

Analogously, the aggregate change in unemployment is

$$\Delta \bar{U} = (\pi_i^a + \pi_o^a - \pi) + c(w_i + \pi_i^r) + (1 - c)(w_o + \pi_o^r), \quad (5)$$

and substitution yields

$$\Delta\bar{U} = cw_i + (1 - c)w_o - \pi, \quad (6)$$

though in equilibrium, since all unions are identical by assumption, and

$$\Delta\bar{U} = w - \pi = 0. \quad (7)$$

### 1.1.5 Equilibrium

Solve the monetary authority's problem first. It must maximize:

$$\max V_M(\pi) = -\iota\pi^2 - (1 - \iota)(\bar{U} + \Delta\bar{U})^2 \quad (8)$$

Substituting for  $\Delta\bar{U}$  and setting the partial derivative wrt  $\pi$  equal to zero yields:

$$\pi^*(w_i) = (1 - \iota)[\bar{U} + cw_i + (1 - c)w_o] \quad (9)$$

Unions then maximize their own utility,

$$\max V_{U_i}(w_i) = \alpha(w_i - \pi) - (1 - \alpha)(U_i + \Delta U_i)(\bar{U} + \Delta\bar{U}) \quad (10)$$

To find the equilibrium nominal wage demand of union  $i$ , we substitute for  $\pi^*$ ,  $\Delta\bar{U}$ , and  $\Delta U_i$ , set the partial derivative wrt  $w_i$  equal to zero, and (noting that in equilibrium,  $w_i = w_o$ ), find:

$$w^* = \frac{\alpha(1 - c - c\iota) - (1 - \alpha)\iota\bar{U}(c^2 - 2c + 2\iota c + 1)}{(1 - \alpha)\iota(c^2 - 2c + 2\iota c + 1)} \quad (11)$$

and thus, using the equilibrium condition  $\Delta\bar{U} = w^* - \pi^* = 0$ ,

$$U^* = \frac{\alpha(1 - c - c\iota)}{(1 - \alpha)(c^2 - 2c + 2\iota c + 1)} \quad (12)$$

### 1.1.6 Comparative statics

## 1.2 Banks, Unions, and Partisan Governments (Adolph, 2001)

### 1.2.1 Additional Background

Lange and Garrett: Complementarity between parties and labor market institutions (left + strong unions, or right + weak unions best)

Alesina et al: Partisan cycles

### 1.2.2 Play of the game and intuition

First unions and the government implicitly (or perhaps explicitly, in social pacting) bargain over unions' wage demands and the government's promise of social policy; the union may choose to demand lower wages for more promised policy benefits. Then the monetary authority chooses the price level. Finally, the government chooses how much policy to actually provide.

This game offers the possibility that governments could induce restraint in wage demand by offering a social policy reward. It harkens back to Lange and Garrett's claim of complementary party/union arrangements, but puts this in a Calmfors-Driffil/Iversen context. That is, wage restraint is enforced by the market or by encompassing unions in the extremes of CWB, but in mid-level CWB, restraint is sorely need, and could be encouraged by a non-accomodating central bank (Iversen) and/or a government-sponsored social policy bargain (again, either "ups the ante" for moderately centralized unions).

By assumption (to be relaxed in later versions of the model), the right cannot credibly commit to providing social policy (or can credibly commit only to some  $P_R < P_L$ , so that wage-restraining bargains are potentially more extensive under the left). This should imply permanent, labor-market contingent partisan cycles, strongest in moderately centralized labor markets.

### 1.2.3 Preference functions

*Unions:*

$$V_{U_i} = \zeta\alpha(w_i - \pi) - \zeta(1 - \alpha)U_i\bar{U} - (1 - \zeta)P \quad (13)$$

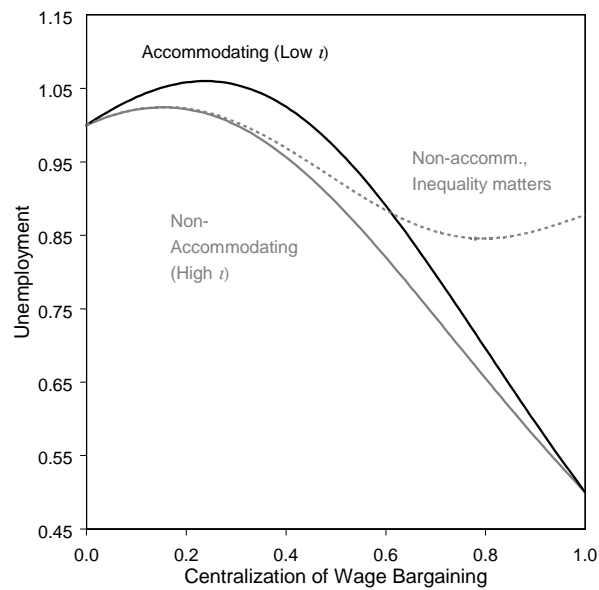


Figure 1: Predictions from Iversen’s model of banks and bargainers: equilibrium employment in Iversen’s model of union-central bank interaction in three different scenarios: an accommodating central bank (dark line), a non-accommodating central bank interacting with unions unconcerned with inequality (solid gray line), and a non-accommodating central bank faced with unions that care about wage equality (dashed gray line).

which is conveniently rewritten as a function of  $w_i$  and  $P$ , the social policy benefit:

$$V_{U_i} = \zeta W_{U_i}(w_i) - (1 - \zeta)P \quad (14)$$

*Monetary authority:*

$$V_M = -\iota\pi^2 - (1 - \iota)\bar{U}^2 \quad (15)$$

*Partisan government:*

$$V_G = -\lambda\pi^2 - (1 - \lambda)\bar{U}^2 - P^2 \quad (16)$$

The government is a new player who dislikes inflation and unemployment, and who can choose to provide (costly) social policy  $P$ . It is convenient to have government utility as a function of  $w_i$  and  $P$ :

$$V_G = W_G(w_i) - P^2 \quad (17)$$

#### 1.2.4 Equilibrium

Solving backwards from the second stage, unions and governments expect the monetary authority to set the price level subject to:

$$\pi^*(w_i) = (1 - \iota)[\bar{U} + cw_i + (1 - c)w_o] \quad (18)$$

as in Iversen. The government and unions choose the Nash bargaining levels of  $(w_i, P)$  subject to this response, satisfying the following condition:

$$\gamma \ln[V_{U_i}(w_i, P) - V_{U_i}(\hat{w}, 0)] + (1 + \gamma) \ln[V_G(w_i, P) - V_G(\hat{w}, 0)] \quad (19)$$

$\gamma$  reflects the bargaining power of union  $i$  w.r.t. the government, and  $\hat{w}$  denotes the equilibrium wage without bargaining.

Differentiating the above yields the following first order conditions:

$$\frac{\gamma \zeta W'_{U_i}(w_i)}{\zeta W_{U_i}(w_i) + (1 - \zeta)P^2 - \zeta W_{U_i}(\hat{w}_i)} + \frac{(1 - \gamma) W'_G(w_i)}{W_G(w_i) - P^2 - \zeta W_G(\hat{w}_i)} = 0 \quad (20)$$

and

$$\frac{\gamma(1-\zeta)P}{\zeta W_{U_i}(w_i) + (1-\zeta)P^2 - \zeta W_{U_i}(\hat{w}_i)} + \frac{(1-\gamma)P}{W_G(w_i) - P^2 - \zeta W_G(\hat{w}_i)} = 0 \quad (21)$$

Solving for  $P$  and rearranging yields the following two equilibrium conditions for  $P$  and  $w_i$ :

$$P = \left\{ W_G(w_i) - W_G(\hat{w}_i) + \frac{\zeta(1-\gamma)}{1-\zeta} [W_{U_i}(w_i) - W_{U_i}(\hat{w}_i)] \right\}^{\frac{1}{2}} \quad (22)$$

and

$$\begin{aligned} & \left\{ W_G(w_i) - W_G(\hat{w}_i) + \frac{\zeta(1-\gamma)}{1-\zeta} [W_{U_i}(w_i) - W_{U_i}(\hat{w}_i)] \right\} \\ & \quad \times [\gamma\zeta W'_{U_i}(w_i) + (1-\gamma)(-\zeta)W'_G(w_i)] \\ = & \left\{ \gamma\zeta W'_{U_i}(w_i) [W_G(w_i) - W_G(\hat{w}_i)] + (1-\gamma)W'_G(w_i) [W_{U_i}(w_i) - W_{U_i}(\hat{w}_i)] \right\}^2 \quad (23) \end{aligned}$$

The latter condition is quartic in both  $U$  and  $w$ . Very messy, especially since we need to solve for each! Still can grind out comparative statics (using the quartic formula plus numerical methods).

### 1.2.5 Comparative statics

## 2 Testing Empirical Implications

### 2.1 Banks and bargainers: Iversen's model

#### 2.1.1 Data

For  $c$ , uses centralization of wage bargaining (detailed time series for 15 countries). For  $\iota$ , uses an average of CBI measures and 'exchange rate fixity'. Both show much cross-sectional variation and some temporal variation.

#### 2.1.2 Method and specification

To test a Calmfors-Driffil model, one might estimate a model like:

$$UDIFF_{it} = \dots + \theta_1 C_{it} + \theta_2 C_{it}^2 + \theta_3 I_{it} + \dots \quad (24)$$

where  $C$  denotes centralization of wage bargaining and  $I$  is CBI. However, this would only allow *either* a hump or a U-shape, but not both. Iversen thus considers the following generalization:

$$UDIFF_{it} = \dots + (\theta_1 C_{it} + \theta_2 C_{it}^2)(k - I_{it}) + \theta_3 I_{it} + \dots, k > 0 \quad (25)$$

If  $k > I$ ,  $UDIFF$  is hump-shaped in  $C$ , but if  $k < I$ , a U-shape obtains. Multiplying through by  $k - I_{it}$  allows us to estimate an equivalent specification by OLS:

$$UDIFF_{it} = \dots + \beta_1 C_{it} + \beta_2 C_{it}^2 + \beta_3 I_{it} + \beta_4 C_{it} \times I_{it} + \beta_5 C_{it}^2 \times I_{it} + \dots \quad (26)$$

#### 2.1.3 Results

From Adolph (2001), re-estimated on quarterly data. Model as above, plus two lags of  $UDIFF$ , country fixed effects, and controls. Standard errors are panel-corrected.

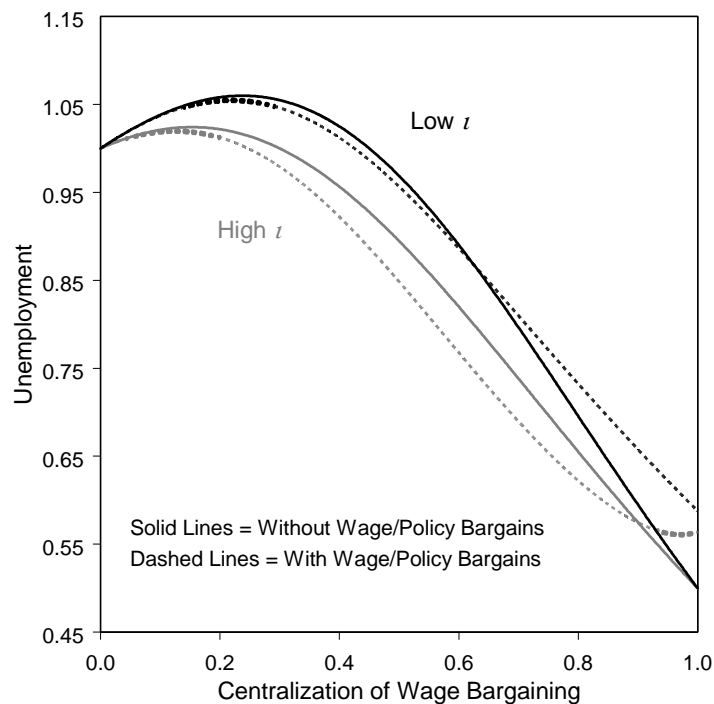
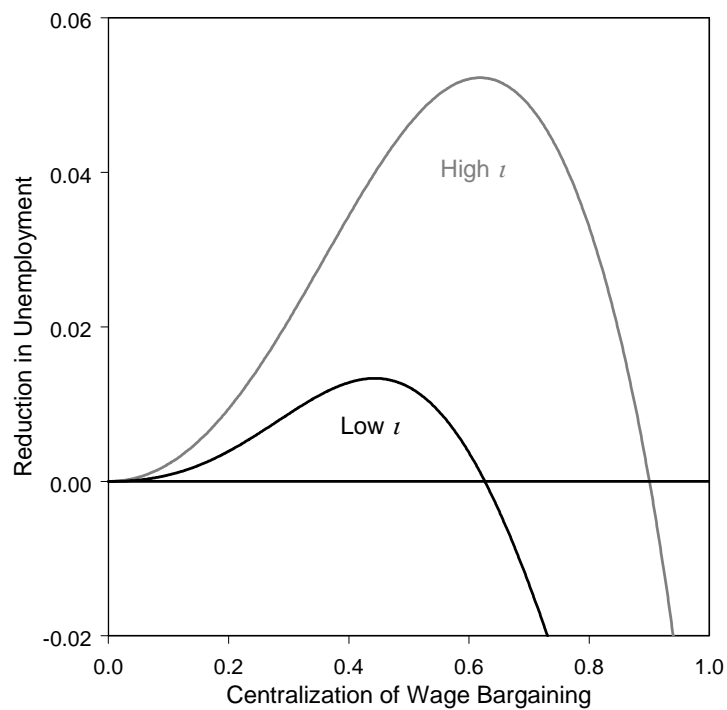


Figure 2: Predictions from Adolph’s model of banks and bargainers: Predicted unemployment levels for different combinations of labor market institutions and monetary regimes. Solid lines reflect equilibrium unemployment without social policy bargaining (or Iversen’s predictions from Figure 1). Dotted lines show unemployment when the government and unions trade wage restraint for social policy. The difference between the solid and dotted lines is the unemployment benefit of left government. The dark lines represent more accommodating monetary regime ( $\tau = 0.55$ , while the predictions in gray assume non-accommodating central banks ( $\tau = 0.7$ ). For both dotted lines, unions care equally about wages, unemployment and social policy ( $\alpha = 0.5$  and  $\zeta = 0.67$ ), and the government values low unemployment over low inflation ( $\lambda = 0.2$ ). For solid lines, unions do not care about social policy ( $\zeta = 1$ ), making policy bargaining irrelevant. All predictions assume the government and unions have equal bargaining power ( $\gamma = 0.5$ ).



**Figure 3:** This plot shows the reduction in unemployment produced by social policy bargains (the difference between the solid and dotted lines in Figure 2) given different monetary regimes and labor market institutions. Higher values on the vertical axis correspond to larger reductions in unemployment under left-wing governments. All parameters match Figure 2.

## 2.2 Banks, Unions, and Partisan Governments (Adolph, 2001)

### 2.2.1 Data

As in Iversen, plus ARC's quarterly partisan data (updated).

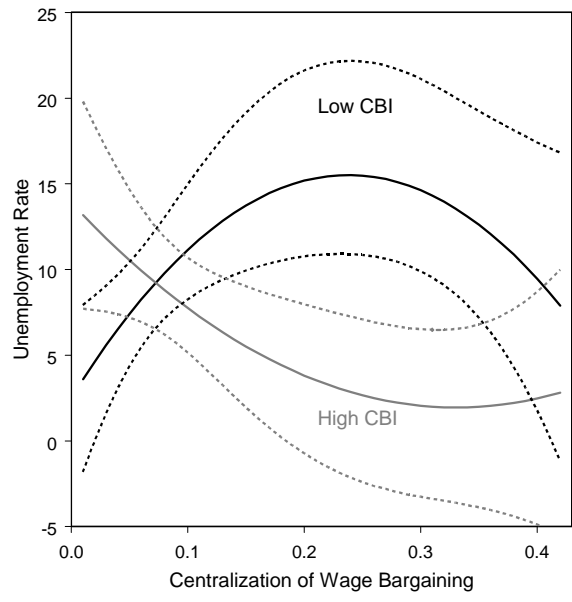
### 2.2.2 Method and specification

As in Iversen, OLS estimation with panel-corrected standard errors. Even more interaction terms (Iversen's specification remains a special case):

$$\begin{aligned} UDIF_{it} = & \dots + \beta_1 C_{it} + \beta_2 C_{it}^2 + \beta_3 I_{it} + \beta_4 C_{it} \times I_{it} + \beta_5 C_{it}^2 \times I_{it} + \\ & + \beta_6 CV_{i,t-2} + \beta_7 ADM_{it} + \beta_8 ADM_{it} \times C_{it} + \beta_9 ADM_{it} \times C_{it}^2 \\ & + \beta_{10} ADM_{it} \times C_{it} \times I_{it} + \beta_{11} ADM_{it} \times C_{it}^2 \times I_{it} + \dots \end{aligned} \quad (27)$$

### 2.2.3 Results

Given the many interaction terms, the best way to understand the results is graphically, looking at the change in expected unemployment under different counterfactuals.



**Figure 4:** Estimated long-run effects from Iversen’s model of banks and bargainers: Solid lines reflect the limit to which an economy would converge given fixed institutions and government. Black curves reflect accommodating central banks (1.5 s.d. below the mean level), while gray curves reflect non-accommodating central banks (1.5 s.d. above the mean). Dotted lines are 90% confidence intervals. These predictions and confidence intervals are based on 100,000 simulations of Model 3, with partisanship and other controls held at their mean values.

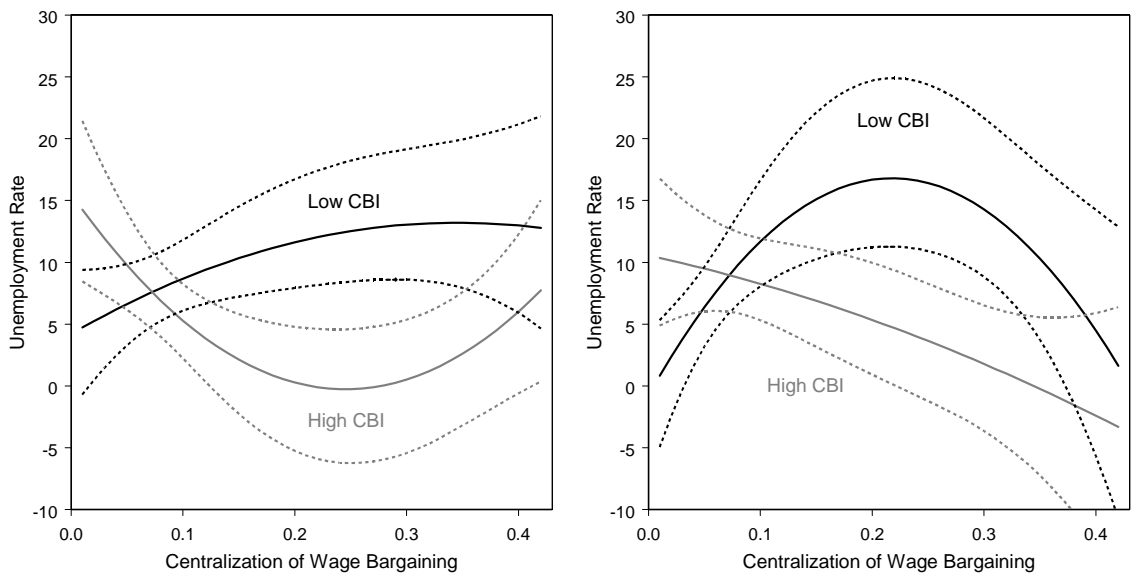


Figure 5: Long term results from Adolph’s model of banks and bargainers: Solid lines reflect the limit to which an economy would converge given fixed institutions and government. Black curves reflect accommodating central banks (1.5 standard deviations below the mean), while gray curves reflect non-accommodating central banks (1.5 standard deviations above the mean). Dotted lines are 90% confidence intervals. These predictions and confidence intervals are based on 100,000 simulations of Model 3, with controls held at their mean values.

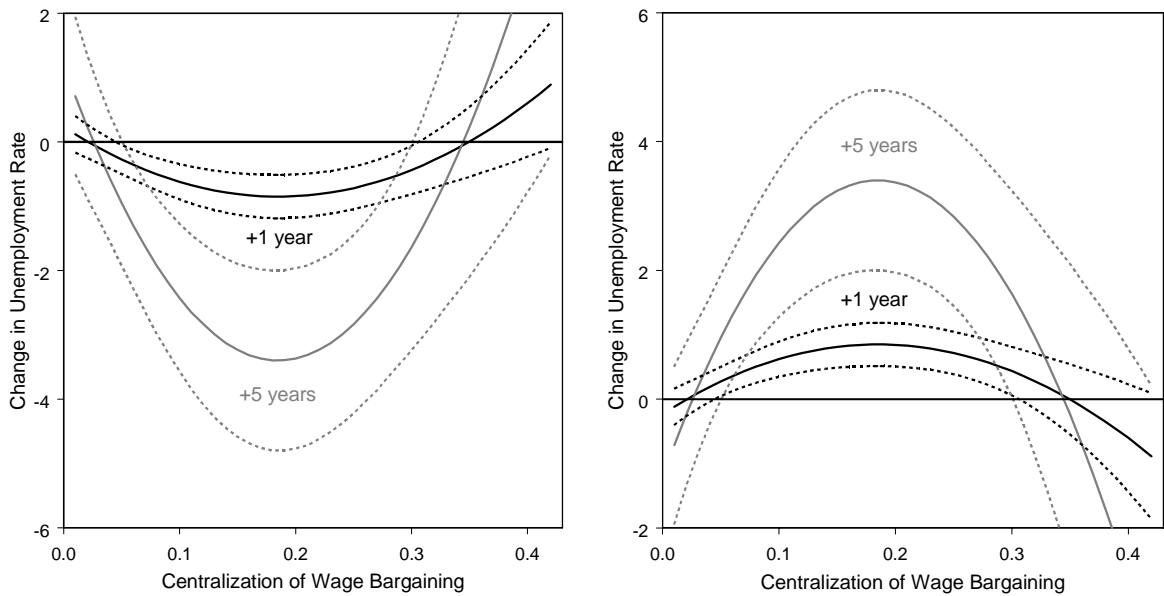


Figure 6: Short term results from Adolph's model of banks and bargainers: The left panel shows the simulated effect of a left-wing electoral victory after a long period of rule by the right; parties are reversed in the right panel to show the increase in unemployment after conservative electoral victory. Black curves are the cumulative change in unemployment one year after the election, while gray curves are the cumulative change in unemployment five year after the election. Dotted lines are 90% confidence intervals. Predictions based on 100,000 simulations of Model 3, iterated through twenty periods, with partisan variables changing appropriately over the five year period.

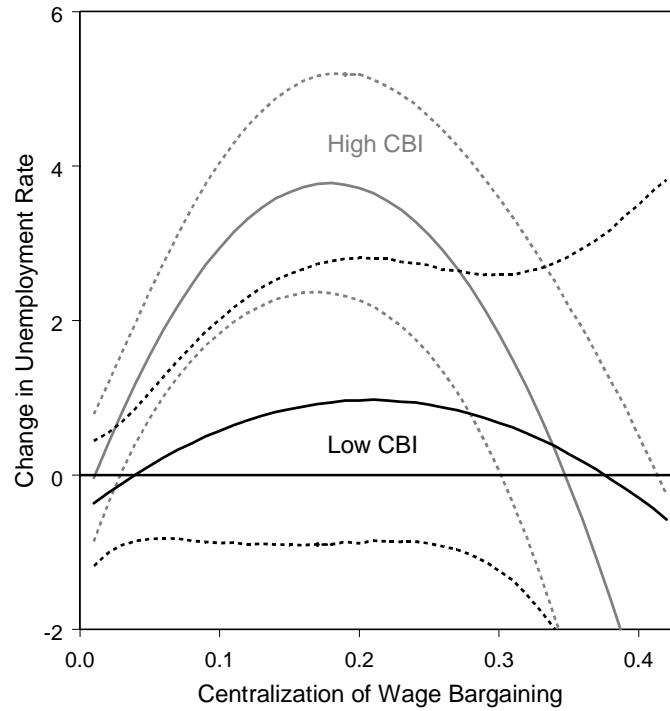


Figure 7: Short term results from Adolph's model of banks and bargainers, fully interactive specification: The simulated change in unemployment three years after a right-wing government replaces a long-standing left-wing administration, according to the monetary regime. Black curves show the change in unemployment given accommodating central banks (1.5 standard deviations below the mean), while gray curves reflect non-accommodating central banks (1.5 standard deviations above the mean). Dotted lines are 90% confidence intervals. Predictions based on 100,000 simulations of Model 4, iterated through twelve periods, with partisan variables changing appropriately over the three year period.

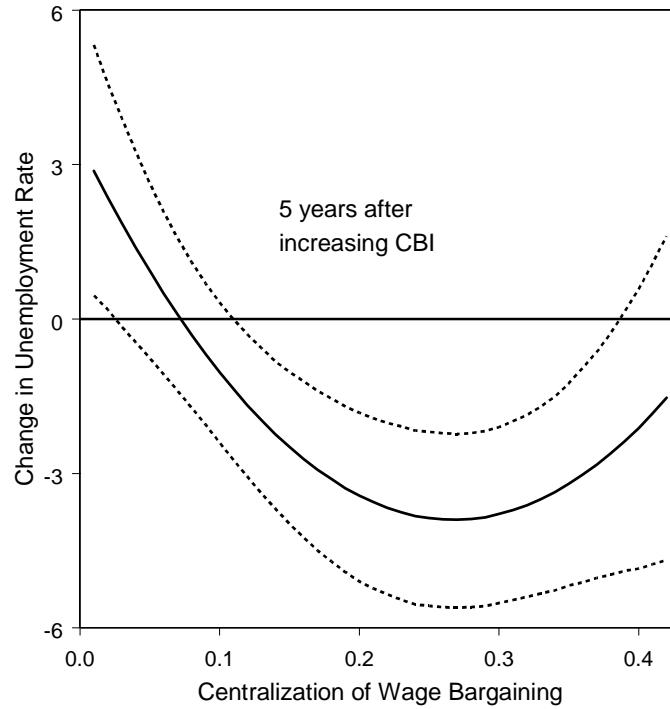


Figure 8: The unemployment cost or benefit of central bank independence depends on labor market organization: Solid lines reflect the limit to which an economy would converge given fixed institutions and government. Black curves reflect accommodating central banks (1.5 s.d. below the mean level), while gray curves reflect non-accommodating central banks (1.5 s.d. above the mean). Dotted lines are 90% confidence intervals. These predictions and confidence intervals are based on 100,000 simulations of Model 3, with partisanship and other controls held at their mean values.