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Collective Bargaining and Its Effect on the Central Bank Conservatism: Theory and Some Evidence[1]

by

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Abstract

The primary purpose of this paper is to investigate, both theoretically and empirically, the relationship between the socially optimal degree of central bank conservatism and the level of unionization. The theoretical framework suggests a clear and negative relationship between the two, such that the lower the level of unionization, the higher the socially optimal degree of central bank conservatism. This result is derived from the combination of two effects that operate when the level of unionization changes. These effects can be identified as the "competition effect" and the "strategic effect". An increase in the proportion of unionized labor force reduces competition in the labor market and, as a result, induces the central bank to choose higher inflation in order to erode real wages ("competition effect"). Simultaneously, an increase in unionization leads to real wage moderation by the union as it desires to avoid inflation ("strategic effect"). Because this moderation will be greater the greater the weight that the central bank ascribes to unemployment stabilization, a more liberal central bank is socially preferred. In case the union's inflation-aversion is sufficiently high, the combination of these two effects produces a hump-shaped relationship between the level of union density and both unemployment and inflation (a Calmfors-Driffill relationship). The paper also presents an empirical examination based on panel data from over 48 countries. The analysis provides some support for the theoretical model's prediction about the negative relationship between collective bargaining and central bank conservatism as measured by legal independence.

***Key words*:** Central bank conservatism, collective bargaining, inflation, labor market, trade unions, unemployment.

JEL Classification: *E50, E58, J50, J51.*

1. Introduction

In recent years a great effort has been made to understand the possible impact of institutional arrangements on national economic performance. The two common and contradictory hypotheses - which argue that on the one hand, market institutions and regulation produce rigidities that damage economic performance, and on the other hand, that those institutions can overcome various market failures and therefore be beneficial to national economic performance [Bruno and Sachs (1985)][1] – have been challenged by a third hypothesis put forward by Clamfors and Driffill (1988). The latter argue that the relationship between the labor market structure and economic performance is non-linear, i.e., countries with either centralized or decentralized bargaining systems are likely to outperform those with intermediate bargaining. In their view, the hump-shaped pattern between centralization and economic performance results from two main forces that moderate real wages at extreme levels of centralization. The first force dominates at low levels of centralization because the unions, which face elastic labor demand, tend to moderate their wage demands in order to avoid unemployment among their members. The second force dominates at high levels of centralization as unions internalize the negative externalities of their actions on macroeconomic outcomes, and as a consequence they moderate their wage demands. At intermediate levels of centralization, both forces are relatively low and hence real wages are relatively high.

Empirically, the robustness of Clamfors and Driffill's view seems to be rather fragile as the statistical findings change with the period of estimation, the measurement of bargaining structure,[2] the indices of economic performance (unemployment, inflation, real wages, employment, etc.) and the indices of bargaining power (centralization, co-ordination, corporatism, union density, etc.). For instance, Freeman (1988) shows that the non-linear relationship is reflected not only in the level of centralization, but also in wage dispersion - an index that may reflect the level of wage-bargaining

[1] Bruno and Sachs (1985) show that high "corporatism" is associated with low inflation and low unemployment as measured by the "misery index".

[2] Soskice (1990) argues that Clamfors and Driffill's categorization of bargaining structure was inaccurate for Japan and Switzerland, two (out of seventeen) countries, and that when these countries were treated properly, the data supported a linear rather than a nonlinear relationship between bargaining structure and performance.

centralization. Bleaney (1996) presents a game between inflation-indifferent unions and a central bank in a framework where firms have the market power to set prices. Although his theoretical results predict a hump-shaped relationship between the number of unions and both inflation and unemployment, his empirical findings indicate a hump-shaped relationship only between centralization and unemployment. In addition, he finds a negative relationship between unemployment and the level of corporatism.[3] Scarpetta (1996) examines the effect of several institutional factors on unemployment. Regarding centralization, his findings are compatible with Clamfors and Driffill's hump-shaped pattern, but workers' bargaining power, as proxied by union density, seems to be associated with higher unemployment. Grier (1997) argues that economic performance depends on the interaction between the level of corporatism and the level of union density, such that higher union density under corporatist governments can promote economic growth, whereas higher union density under non-corporatist governments can depress it. Similarly, Nickell (1997) finds that high union density and low levels of co-ordination between employers' associations and trade unions produce higher unemployment. The OECD (1997), which analyses the effects of several characteristics of collective bargaining on different measures of economic performance, finds that higher centralization and coordination are correlated with lower unemployment.

However, the studies mentioned above do not consider the effect of central bank conservatism. By using a theoretical framework, Cukierman and Lippi (1999) argue that Clamfors and Driffill's hump-shaped pattern exists only when central bank conservatism is below a sufficient level, while high central bank conservatism generates a monotonic and increasing relationship between centralization and both unemployment and inflation.[4] Their results stem from the fact that at low levels of centralization, unions face elastic labor demand and thus moderate their wage demands to avoid unemployment among their members. At a high level of centralization, inflation-averse unions moderate their wage demands in order to avoid high inflation. This moderation will take place only if the central banker is sufficiently liberal, i.e., willing to tolerate high inflation in order to achieve low

[3]Bleaney also finds that central bank independence is correlated with low inflation. He does not find any correlation between central bank independence and unemployment.

unemployment. Cukierman and Lippi's empirical analysis supports their model's predictions. Guzzo and Velasco (1999) also use a theoretical model to examine the interaction between the central bank's conservatism, centralization and economic performance. In contrast with the results of Cukierman and Lippi, they find that the relationship between economic performance (inflation and unemployment) and centralization is either U-shaped or monotonically decreasing, depending on the elasticity of substitution between labor types.[5] Chou (2001) provides empirical support for Guzzo and Velasco's prediction with his findings of a U-shaped relationship between unemployment and union density, and empirical support for Cukierman and Lippi's prediction with his findings of a hump-shaped relationship between inflation and the Herfindahl centralization index.

The following paper departs from the theoretical models mentioned above, primarily in the theoretical framework used to analyze the institutional arrangements on economic performance. Unlike previous papers that assume a homogenous labor market in which all workers are unionized under one or more labor unions, this paper focuses on a two-sector labor market, which differs in the wage determination. In one sector, the "unionized sector", workers are unionized under one inflation-averse union; hence they coordinate in order to achieve their preferred real wage whereas in the second sector, the "competitive sector", workers act independently and, as a consequence, lack bargaining power. In this "competitive" sector, real wages clear the market.

In addition, this framework is utilized to evaluate the impact of various parameters on the socially optimal degree of central bank conservatism, and in particular – to evaluate how the latter is affected by the relative weight of the unionized sector in the labor market. The socially optimal degree of central bank conservatism was initially examined by Rogoff (1985). Rogoff shows that in the presence of an inflationary bias and supply shocks, the optimal level of central bank conservatism will be higher than that of the society, but lower than infinity. According to his model in the absence of

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[4] In their theoretical model, Cukierman and Lippi used the number of unions as a proxy for centralization.

[5] The difference between the results of Cukierman and Lippi and those of Guzzo and Velasco derive from the model's primitive assumptions. In particular, in Guzzo and Velasco's model, the wage elasticity of labor demand facing the individual union is either increasing or decreasing with the number of unions, while in Cukierman and

stabilization motive, the optimal level of conservatism is infinite, because it will eliminate the undesired outcome of inflationary bias. In contrast, Skott (1997) and Guzzo and Velasco (1999) argue that in the absence of supply shocks but in the presence of inflation-averse unions, which act as leading players in a Stackelberg game, an ultra-liberal central bank is socially optimal since it achieves the optimal results – zero inflation and zero unemployment.[6] Similar conclusions are implied in Cukierman and Lippi (1999). Those frameworks assume that the central bank directly controls inflation. In a recent study of monopolistic competition (where firms are price makers), Coricelli, Cukierman and Dalmazzo (forthcoming) demonstrate that the results of an ultra-liberal central banker are valid only in the case of a single inflation-averse union. For other cases (particularly for cases of a low ratio between the unions' inflation-aversion and their unemployment-aversion), the socially optimal central bank would be ultra-conservative. Nevertheless, those papers, which focus either on a competitive labor market or a unionized labor market, fail to predict the explicit link between workers' bargaining power (as proxied by the number of union members) and the socially optimal degree of central bank conservatism. The analysis of this link is one of the main objectives of this paper.

Two main results arise from this framework. One result concerns the relationship between workers' bargaining power and economic performance. As in Bleaney (1996) and Cukierman and Lippi (1999), the following theoretical model also suggests a hump-shaped pattern (a Clamfors-Driffill relationship) between economic performance (inflation and unemployment) and unionization level. Unlike their multi-union model, in this single-union framework the unionization level is characterized by the number of union members as a proportion of the total labor force (union density) and not as the number of unions (centralization) per se. The second result concerns the relationship between workers' bargaining power and the socially optimal degree of central bank conservatism. The comparative statics show that there is a clear and negative relationship between the two, such that the greater the portion of the competitive sector in the labor market, the higher the socially optimal degree of the

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Lippi, the wage elasticity rises with the number of unions and tends to infinity as the number of the unions becomes large.

[6]Guzzo and Velasco (1999) claim that a populist central bank is socially optimal at all levels of centralization of wage bargaining. Their results derived from an implicit assumption that wages are contracted in real terms.

central bank conservatism. An empirical analysis covering more than 48 countries over two decades (the 1980s and the 1990s) supports this view.

The paper is organized as follows. Section 2 presents the general structure of the labor market and the strategic interaction between the central bank, labor union and the wage-setters in the competitive sector. This structure is later utilized to characterize the equilibrium features of some economic variables such as real wages, inflation, inflationary expectations and unemployment. Section 3 analyses the socially optimal degree of central bank conservatism, especially the relationship between the socially optimal degree of central bank conservatism and union density. Section 4 describes the dataset used for the statistical analysis, the empirical methodology, and the estimation results. Section 5 is dedicated to a case study – a description of the evolution of unionization and central bank conservatism in the United Kingdom during the 1980s and the 1990s. Concluding remarks follow in section 6.

2. The Model

2.1 The General Framework

Consider a labor market that contains two sectors: the unionized sector, in which employees coordinate in order to achieve their preferred real wage, and a competitive sector in which workers act independently and therefore lack bargaining power. In this sector, the real wage clears the market. Each sector owns a production technology that exhibits decreasing returns to scale to labor input, given by [7] -

$$(1) \qquad Y_j = AL_j^a \qquad a<1\ , \qquad A>0\ , \qquad j=c,un\ ,$$

where Y_j and L_j are output supply and labor input in sector j (the subscripts un and c denotes the unionized sector and the competitive sector, respectively). By equating the marginal productivity to the real wage, one can obtain labor demand in each sector. In logarithms, the labor demand can be described as:

[7] For simplicity capital is fixed and normalized to 1.

$$(2) \qquad log(L_j^d) \equiv l_j^d = \alpha(d - w_r) \quad ; \qquad d = log(aA) \; ; \qquad \alpha = \frac{1}{1-a}$$

where w_r is the log of the real wage ($w_r = w - \pi$), w is the log of the nominal wage and π denotes the inflation rate during the period ($\pi = p - p_{-1}$). For simplicity and without loss of generality, the log of the price level in the previous period is normalized to zero. The parameter α reflects the elasticity of labor demand with respect to the real wage. A higher α implies that a one-unit change in the real wage has a greater effect on labor demand.

The economy's total labor force is perfectly inelastic and given by l_0 (in logarithms). θ denotes the proportion of the labor force working in the unionized sector (henceforth, this parameter will be referred to as the union density parameter), whereas the complementary proportion $(1-\theta)$ denotes the share of those working in the competitive sector. Accordingly, the labor supply in each sector can be written as

$$(3) \quad l_{un}^s = \theta l_0 \,,$$

$$(3') \quad l_c^s = (1-\theta) l_0 \,.$$

The unemployment rate in each sector (u_j) can be obtained by subtracting labor demand from labor supply $(u_j = l_j^s - l_j^d)$. In the unionized sector, this yields the following expression:

$$(4) \quad u_{un} = \alpha(w_{r,un} - w_{r,un}^c) = \alpha(w - \pi - w_{r,un}^c) \; ; \qquad w_{r,un}^c = d - \frac{\theta l_0}{\alpha} \,,$$

where $w_{r,un}^c$ expresses the equilibrium (competitive) real wage in this sector (the real wage at which unemployment is equal to zero). Eq. (4) reveals that the unemployment rate is increasing in the gap between the actual real wage $(w_{r,un})$ and the equilibrium real wage. This gap will be henceforth referred to as the real wage premium.

In the competitive sector the real wage clears the market, so the real wage premium is equal to zero. However since workers would like to avoid real wage erosion during the period, they internalize expected inflation within nominal wage contracts. Hence, in this sector, the unemployment increases with unexpected inflation:

$(4')$ $u_c = \alpha(\pi^e - \pi)$.

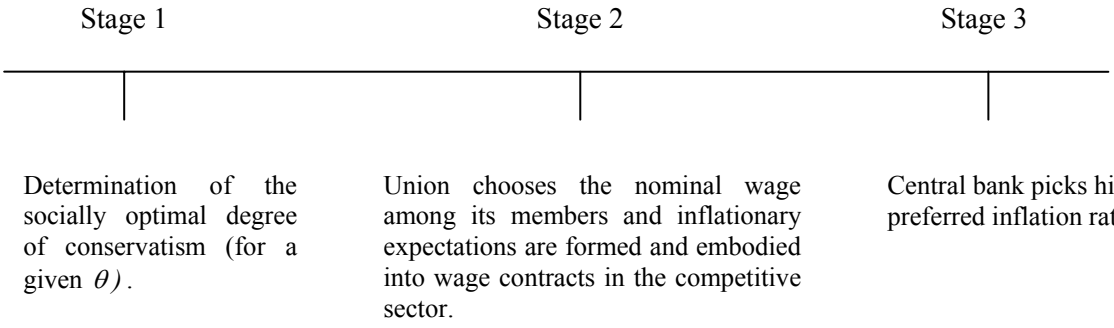
Using Eq. (4) and Eq. (4'), the total unemployment rate (u) can be described as the weighted average of the unemployment rate in each sector:

(5) $u = \theta u_{un} + (1-\theta)u_c$,

$(5')$ $u = \alpha[\theta(w - w^c_{r,un}) + (1-\theta)\pi^e - \pi]$.

2.2 Timing of Events within the Period

Figure 1 - Timing of moves



In order to examine the relationship between union density (θ) and the optimal level of conservatism, I focus on the following three-stage sequence of events. First, given the distribution of the labor force over the two sectors, society appoints a central banker in order to minimize its expected loss in the following period (as in Rogoff, 1985).[8] In particular, society chooses the socially optimal degree of conservatism (the relative weight that the central banker ascribes to the price stability objective versus the employment stability objective) among a continuous and infinite number of alternatives. In the second stage the nominal wage in both sectors is determined. While in the unionized sector, where employees act in coordination, the real wage is chosen (through the nominal wage) in order to minimize the union's expected loss function; in the competitive sector, where the real wage clears the market, the nominal wage changes according to inflationary expectations (assuming rational

expectations). In the third stage, the appointed central banker, who acts by discretion, picks his preferred inflation rate in order to minimize its expected loss function after observing nominal wage determination in both sectors.

2.3 The Central Banker's Strategy

In order to obtain the optimal strategies in each stage, the model is solved backwards, beginning with the optimal behavior of the central bank. As in Barro and Gordon (1983), the central bank wishes to minimize variability of unemployment and inflation around a desired rate. For convenience, the desired rate is normalized to zero. The central banker's loss function is given by:

$$(6) \quad \tau = \frac{1}{2}u^2 + \frac{I}{2}\pi^2 \qquad I > 0,$$

where the parameter I is positive and measures the relative importance that the central banker assigns to the objective of low inflation versus low unemployment. A higher I implies that the central bank is more conservative, i.e., attributes a greater weight to price stability than to unemployment stability. By inserting Eq. (5') into the central banker's loss function [Eq. (6)] and minimizing it with respect to π, one can obtain the following central bank reaction function:

$$(7) \quad \frac{\partial \tau}{\partial \pi} = 0 \;\Rightarrow\; \pi = \frac{\alpha^2}{\alpha^2 + I}[\theta(w - w^c_{r,un}) + (1-\theta)\pi^e].$$

Because the central bank acts by discretion, it increases the inflation rate as the nominal wage in both sectors rises. As one can see, union density (θ) and the complementary proportion $(1-\theta)$ reflect the weight that the central bank ascribes to each sector in its reaction function. In addition, the parameters α and I have a direct and clear impact on the central bank's preferred inflation but in opposite directions: higher elasticity of labor demand (higher α) induces the central bank to react to nominal wage determination at greater magnitude, because unemployment stabilization will be accompanied by lower inflation variability; whereas higher conservatism (higher I) reduces the incentive to react, because the central banker ascribes less importance to unemployment stabilization. Eq. (7) also

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[8]The distribution of the labor force over the two sectors is fixed during the entire period.

demonstrates that the existence of inflationary bias depends solely on the existence of a unionized labor force. If the labor force is not unionized $(\theta = 0)$, there will be no inflationary bias $(\pi = \pi^e = 0)$.

2.4 The Choice of the Nominal Wage by the Union

Like the central bank, the union also desires to reduce unemployment and minimize inflation fluctuations around a zero rate.[9] In addition, the union is also motivated to increase the real wage level among its members. Following Cukierman and Lippi (1999), the union loss function can be expressed as

$$(8) \quad \Omega_{un} = \frac{\delta}{2} u_{un}^2 + \frac{\gamma}{2} \pi^2 - w_{r,un} \ ,$$

where the parameters δ and γ denote the weight that the union ascribes to unemployment and inflation relative to its real wage objective. Since the union acts before the central bank, and since it knows the central bank's reaction function, it plays strategically as a leading player, and determines its preferred real wage by setting the nominal wage directly. In addition, the union takes the inflationary expectations as given. By inserting the central bank's reaction function [Eq. (7)] into the union's loss function [Eq. (8)] and minimizing it with respect to the nominal wage, one can obtain the union's reaction function:

$$(9) \quad \frac{\partial \Omega_{un}}{\partial w} = 0 \ \Rightarrow \ w = w_{r,un}^c + \frac{[I + \alpha^2 (1-\theta)](\alpha^2 + I) + \pi^e \alpha^4 (1-\theta)\{\delta[I + \alpha^2 (1-\theta)] - \gamma\theta\}}{\alpha^2 \{\delta[I + \alpha^2 (1-\theta)]^2 + \gamma\theta^2 \alpha^2\}}.$$

Eq. (9) shows that the union always sets the nominal wage above the equilibrium real wage in order to maintain a high real wage. This incentive induces the union to pick a higher nominal wage as inflationary expectations increase in order to avoid erosion of the real wage resulting from the central bank's reaction. Other things being equal, an increase in the inflation-aversion parameter (γ)

[9]The union's inflation aversion can be motivated by the observation that in many cases the pensions of the union workers are not indexed, and that union members, like other individuals, generally dislike inflation.

moderates the nominal wage because of union awareness that higher nominal wages lead to higher inflation. In the extreme case, in which the entire labor force is unionized, the nominal wage would be

$$(9')\quad w(\theta = 1) = w^{c}_{r,un} + \frac{I^2}{\alpha^2 (I^2\delta + \alpha^2\gamma)}\ .$$

2.5 Features of Equilibrium Outcomes

By inserting the union reaction function [Eq. (9)] into the central bank reaction function [Eq. (7)], and applying the rational expectations assumption, one can obtain the equilibrium levels of the real wage, the inflation rate, inflationary expectations and unemployment rate for any level of union density (θ) and central bank conservatism. The equilibrium results are presented in Eq. (10) – Eq. (12), below:

$$(10)\quad w_{r,un} = w^{c}_{r,un} + \frac{I[I + \alpha^2(1-\theta)]}{\alpha^2\{I\delta[I + \alpha^2(1-\theta)] + \gamma\theta^2\alpha^2\}} = w^{c}_{r,un} + \phi\,,$$

$$(11)\quad \pi = \pi^{e} = \frac{\theta[I + \alpha^2(1-\theta)]}{I\delta[I + \alpha^2(1-\theta)] + \gamma\theta^2\alpha^2} = \frac{\theta\alpha^2}{I}\phi\,,$$

$$(12)\quad u = \theta u_{un} = \frac{\theta I[I + \alpha^2(1-\theta)]}{\alpha\{I\delta[I + \alpha^2(1-\theta)] + \gamma\theta^2\alpha^2\}} = \alpha\theta\phi\,.$$

Eq. (11) and Eq. (12) reveal that both the inflation rate and the unemployment rate depend positively on the real wage premium, ϕ. Note that θ affects inflation and unemployment directly as well as through ϕ. In the extreme case, in which none of the labor force is unionized $(\theta = 0)$, the real wage clears the labor market and, as a consequence, the central bank picks a zero inflation rate. As long as there is a positive union density, an increase in the real wage premium will increase the unemployment rate and - in equilibrium - also increase the inflation rate. Two parameters that have a clear and direct effect over the real wage premium are the union's inflation and unemployment aversion (γ and δ, respectively). An increase in the union's inflation aversion moderates the union's nominal wage demand at a higher rate than it moderates inflation (the nominal wage is reduced because the union wants to avoid high inflation). As a result, the real wage premium decreases. The negative effect of the unemployment aversion over the real wage premium can be easily seen from Eq. (4).

In the extreme case, in which all the labor force is unionized, inflation and unemployment will be:

$$(11') \quad \pi(\theta=1)=\pi^{e}(\theta=1)=\frac{I}{\delta I^{2}+\gamma\alpha^{2}} \qquad ; \qquad (12') \quad u(\theta=1)=u_{un}=\frac{I}{\alpha[I\delta+\gamma\alpha^{2}]}$$

Eq. (11') and Eq. (12') reveal that in a single-union framework, where the entire labor force is unionized, it will be socially optimal to appoint an ultra-liberal central banker $(I=0)$ in order to minimize losses from unemployment as well as from inflation. This result, that was also obtained by Cukierman and Lippi (1999), Guzzo and Velasco (1999) and others, derived from the fact that once the central bank tolerates any inflation to maintain unemployment stability, an inflation-averse union will reduce its real wage premium to zero and, in equilibrium, both unemployment and inflation will also be equal to zero.

The effect of the central bank conservatism and union density on the equilibrium inflation and unemployment rate is summarized in the following two propositions:

Proposition 1: *An increase in central bank conservatism reduces the inflation rate if and only if the ratio between the union's inflation aversion and its unemployment aversion is below the following threshold:*

$$(13) \qquad \frac{\partial\pi}{\partial I}<0 \quad \Rightarrow \quad \frac{\gamma}{\delta}<\frac{[I^{2}+\alpha^{4}(1-\theta)^{2}]}{\alpha^{2}\theta^{2}}\equiv\left(\frac{\gamma}{\delta}\right)_{c},$$

The threshold, which is presented in proposition 1, shows that when union density is very low (close to zero), an increase in central bank conservatism will always lead to a reduction in the inflation rate (at a sufficient level of conservatism), because the impact of the union's wage demands on total unemployment is very limited; as a result, the central bank assigns to the union's actions a very small weight in its reaction function. On the other hand, in the case of high union density, the effect of the central bank conservatism on the equilibrium inflation rate is rather ambiguous and it depends upon the ratio between γ and δ, as well as the level of the central banker's conservatism (I). In this range of union density, with sufficiently high δ and low γ, an increase in the central bank's degree of conservatism will lead to a relatively moderate increase in the real wage, such that the total effect on

inflation will be negative. The opposite will occur if the union's inflation aversion is sufficiently high and the unemployment aversion is sufficiently low. In this case, an increase in the central bank's degree of conservatism will lead to the choice of a much higher real wage, such that the total effect on inflation will be positive (see Figure 2, below).

Proposition 2: *The relationship between union density (θ) and both inflation and unemployment rates will be non-monotonic (a Calmfors-Driffill's hump-shaped relationship), if the union's inflation aversion is above the following threshold (γ_c)* [10]*:*

$$(14) \qquad \gamma > \frac{[I+\alpha^2(1-\theta)]^2 I\delta}{\theta^2\alpha^2(I+\alpha^2)} \equiv \gamma_c .$$

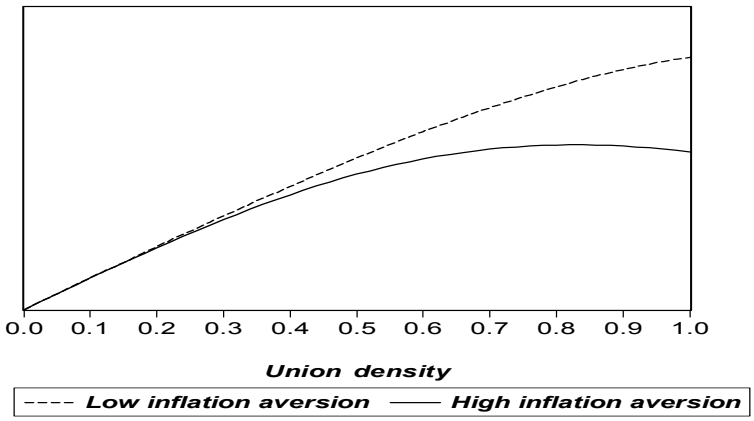
The Calmfors-Driffill hump-shaped relationship in this model is derived from two main effects that operate when union density changes. These effects can be referred as the "competition effect" and the "strategic effect". An increase in the unionized labor force reduces competition in the labor market and, as a result, induces the central bank to choose higher inflation in order to erode the real wage ("competition effect"). Simultaneously, as union density increases, the union embodies the impact of its wage demand on the chosen inflation rate and, as a result, it moderates its wage demands (the "strategic effect"). The magnitude of wage moderation depends, of course, on the inflation-aversion parameter (γ). In case its inflation aversion is above the threshold, as presented in proposition 2, the "strategic effect" will be dominant and both inflation and unemployment will be reduced.

Although this model focuses on a single-union economy, the "strategic effect" is quite similar to the one identified in the multi-union framework of Cukierman and Lippi (1999). Unlike their model, here the "competition effect" that stimulates higher inflation at higher levels of unionization derives from the fact that higher unionization increases the weight that the central bank assigns to the union's wage

[10] This condition is sufficient for both the inflation and unemployment rates because there is a linear relationship between these variables that does not depend on θ ($u = \frac{I}{\alpha}\pi$).

demand in his reaction function.[11] As mentioned, under certain conditions, the combination of "competition effect" and "strategic effect" yields Calmfors-Driffill's hump-shaped relationship.

Figure 2 - Inflation rate and Inflationary expectations



The impact of the central banker's conservatism on the Calmfors-Driffill hump-shaped relationship is summarized in the following proposition and described in Figures 3.a and 3.b below:

Proposition 3: *The level of union density, at which inflation and unemployment rates reach their peak, increases with the central banks conservatism (*for proof, see Appendix).

Figure 3.a - Inflation and inflationary expectations

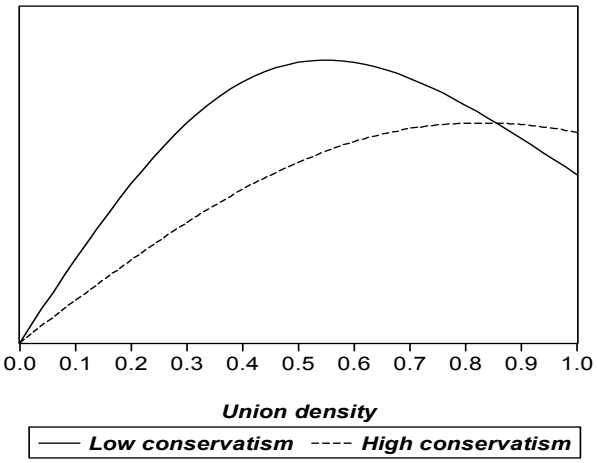
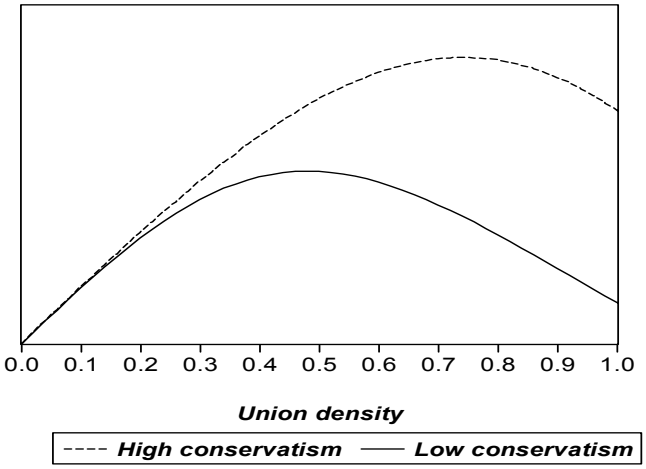


Figure 3.b - Unemployment



[11]In Cukierman and Lippi (1999), the "competition effect" that generates higher inflation at higher levels of centralization stems from the strategic interaction between unions.

The intuition underlying this result is as follows: Once the central bank becomes more conservative, it has a lower incentive to react to wage demands as it assigns more importance to inflation stabilization. As the union is aware of the central bank's incentives, it will reduce the real wage moderation, and - as a result of the "competition effect" – will allow inflation to increase for a wider range of union density.

3. The Socially Optimal Degree of Conservatism

This section analyses the socially optimal degree of conservatism for two main purposes. The primary purpose is to explore the appropriate relationship between central bank conservatism and the economy's level of union density. The results of the analysis will be reviewed in the empirical section. The secondary purpose of this exercise is to utilize this framework to evaluate whether the optimal conservatism is above or below than society's distaste of inflation, an issue that has been the subject of controversy in recent years.

Following Rogoff (1985) and others, let the social loss function be

$$(16)\quad \Lambda = \frac{1}{2}u^2 + \frac{S}{2}\pi^2$$

where $S \in (0,\infty)$ represents the society's relative aversion to inflation, that may generally differ from the relative central bank's inflation-aversion, *I*. By inserting the equilibrium expressions for unemployment and inflation taken from equations (11) and (12) into Eq. (16), one can obtain the optimal level of conservatism $(\hat{I})$ by simply minimizing the following equation with respect to *I* [note that the value of the social loss depends directly on the central bank conservatism, as well as indirectly through the effect that conservatism has on the wage premium $\phi(I)$].

$$(17)\quad \Lambda(I) = \frac{1}{2}[\alpha\theta\phi(I)]^2 + \frac{S}{2}[\frac{\alpha^2\theta}{I}\phi(I)]^2 .$$

The resulting optimal conservatism is (F.O.C):

$$(18)\quad \frac{\partial\Lambda}{\partial I} = 0 \quad \Rightarrow \quad \frac{\hat{I}}{S} = \frac{\delta[\hat{I} + \alpha^2(1-\theta)]^2 - \gamma\theta^2\alpha^2}{\gamma\theta^2[2\hat{I} + \alpha^2(1-\theta)]} .$$

S.O.C is shown in section B in the appendix.

Proposition 4: *At low levels of union density, the socially optimal degree of conservatism is likely to be higher than society's inflation-aversion.*

Proof. See section C in the appendix.

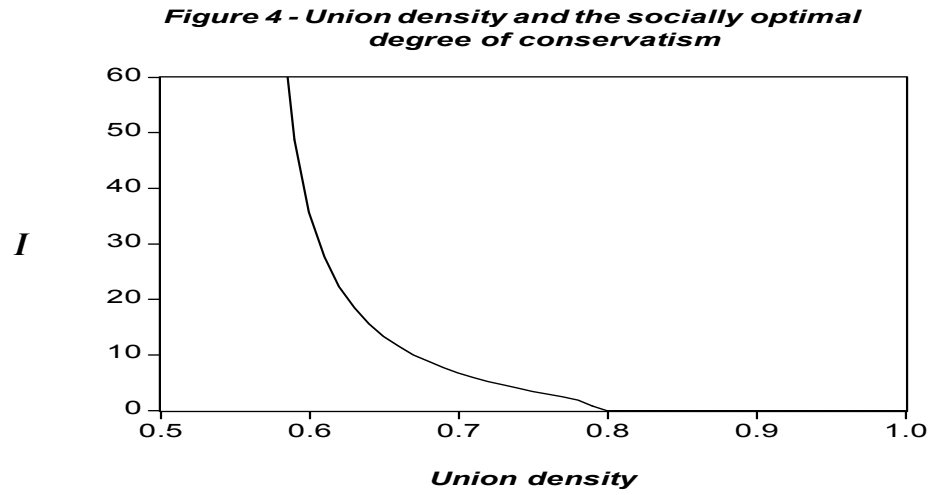
At low levels of union density, the degree of conservatism has a high impact on the level of inflation, whereas it has a low (and quite negligible) effect on unemployment (this impact is illustrated in Figures 3.a and 3.b). Hence, at this range of union density, it is socially optimal to reduce inflation by appointing a central banker with a high degree of conservatism. (As will be explained below, at very low levels of union density, it is even optimal to appoint an ultra-conservative central bank).

3.1 The Link between Union Density and the Socially Optimal Degree of Conservatism

Proposition 5: *If the union is inflation-averse, there will be a negative relationship between union density* (θ) *and the socially optimal degree of central bank conservatism* $(\hat{I})$*, i.e., lower union density leads to a higher degree of the central bank conservatism.*

Proof. See section D in the appendix.

The negative relationship between union density and the socially optimal degree of central bank conservatism (see also Figure 4, below) stems from the fact that higher union density increases the weight that the central bank ascribes to union wage demands in its reaction function. Hence, the link between the central bank conservatism and the union's real wage premium becomes stronger. Given this strong relationship, it is optimal to appoint a more liberal central banker in order to lower the real wage premium (via the union's inflation aversion). At very low levels of union density, where most of the labor force is not unionized, the appointment of an ultra-conservative central banker would be optimal $(I \to \infty)$, because it would yield a zero inflation rate. Obviously, as a result of this choice, an inflation-averse union would increase its real wage premium but, at this level of union density, its effect on total unemployment is quite negligible. At high levels of union density, where most of the labor force is unionized, an appointment of an ultra-liberal central banker would be optimal $(I \to 0)$, because it delivers both low unemployment and low inflation (see Figure 3.a and 3.b). This outcome is derived from the union's fears of inflation [see also Eq. (11') and Eq. (12')].



3.2 Comparative Statics

The following propositions summarize the effect of the various parameters on the socially optimal degree of conservatism:

Proposition 6: *The socially optimal conservatism is higher:*

i. the lower the union's inflation aversion (γ).

ii. the higher the union's unemployment-aversion (δ).

iii. the higher the society's distaste of inflation (S).

Proof. See section E in Appendix.

The underlying intuition regarding the effect of the union's inflation aversion (γ) is as follows: Lower inflation aversion weakens the union's fears of inflation and, therefore, also weakens the link between the central bank conservatism and the union's wage demand. In consequence, it is socially optimal to appoint a more conservative central banker (at any level of union density) in order to achieve lower inflation at broader levels of union density. In the extreme case, in which the union is not inflation averse $(\gamma = 0)$, an ultra-conservative central banker is the socially optimal (see also Figure A.1 in Appendix).[12]

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[12] A quick glance at Eq. (11) and Eq. (12) reveals that in this case, equilibrium inflation is decreasing with central bank conservatism $[\pi = \theta/(I\delta)]$. The latter has no effect on unemployment $[u = \theta/(\alpha\delta)]$ as the union does not have any incentive to moderate its real wage premium. This implies that minimization of social loss occurs when $I \to \infty$.

As the effect of the union's inflation aversion (γ), the channel through which the union's unemployment aversion (δ) affects the socially optimal degree of conservatism also passes through the real wage premium. Thus, higher unemployment-aversion moderates the real wage premium. This effect, which is reflected directly in reduction of the unemployment rate, will lead to the choice of a more conservative central banker in order to obtain a lower inflation rate (see Figure A.2 in the Appendix).

The impact of society's inflation aversion (S) on the optimal degree of conservatism is quite obvious: A higher S means that society ascribes greater importance to price stability than to unemployment stability. Therefore, it will appoint a more conservative central banker whose preferences are closer to the society's inflation-unemployment objectives (see Figure A.3 in the Appendix).

Another result obtained by simulations is that higher labor demand elasticity (α) leads to a higher degree of conservatism. This result stems from the fact that a higher α increases the central bank's incentive to stabilize unemployment around its preferred rate, as it will be accompanied by relatively low inflation variability. Because the union is aware of the central bank's incentive, it will moderate its real wage premium (as long as it is inflation averse) and unemployment among its members. As a result it will be socially optimal to appoint a more conservative central banker in order to reduce the inflation rate for broader levels of union density (see Figure A.4 in the Appendix).

4. Some Evidence

The main purpose of the theoretical model described above is to explore the optimal relationship between levels of unionization in the economy and degree of the central bank conservatism. The model suggests that the relationship between the two is negative, such that the lower the level of the union density, the more conservative the socially optimal central banker will be. The next section evaluates this hypothesis and characterizes the empirical robustness of the result by estimating panel regressions that cover more than 48 countries over two periods of time (1980s and 1990s).[13]

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[13] The basic assumption behind this analysis is that governments tend to choose their central bank's degree of conservatism according to what is the socially optimal.

4.1 The Measurement of Central Banks Conservatism and Trade Union Density

The figures for union density were taken directly from the *World Labour Report* (1997-1998), as measured by two alternative indices: the first index is union members as a percentage of the total wage and salary earners (*TUD)*; the second index is union members as a percentage of the non-agricultural labor force (*NATUD*). Both indices are used because *TUD* does not include many developing countries due to unavailability of the necessary employment data, so that, the sample is quite limited,[14] while *NATUD*, although it encompass a broader set of countries, does not include the agriculture sector, which in some countries has high weight in total production. Note that there are several difficulties involved with the precise measurement of union density as used in the theoretical model because the indices that relate only to union members may not always reflect collective bargaining coverage in the economy. For example, in Australia and in north west Europe (especially in Germany, France, Austria, Italy, Spain, Portugal, Belgium and Netherlands), bargaining coverage is usually more extensive than union coverage while in other countries bargaining coverage may be more limited than union coverage (generally, organizations that are not recognized by the employer are not excluded from the statistics on union representation). Since the relevant data on the collective bargaining coverage rate is very limited and exist only for several OECD countries (primarily for the 1990s), I estimated an additional model that incorporates data on the collective coverage rate (for countries where the data exist) with the data on union density (in countries that lack data on the coverage rate). See section 4.4, below.

For the proxy of the central bank conservatism, I used the index of Central Bank Legal Independence (*LVAW*), developed by Cukierman, Webb and Neyapti (1992) and Cukierman (1992).[15] This index, which ranges continuously between zero (least independent central bank) and one (most independent central bank), measures the ability of central banks to adhere to a price stability objective, and it is

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[14] In many of these countries the line between employment, unemployment or between self-employed and employed for wages, is not easily drawn.

[15] There are also several other indices for central bank independence (CBI), for instance, Bade and Parkin (1988), Alesina (1989), Grilli, Masciandaro and Tabellini (1991) and Eijffinger and Schaling (1993). However, *LVAW* is the most comprehensive.

based on 16 different criteria.[16] Among other things, these criteria include procedures for appointment and dismissal of the CB's governor, the relative importance of price stability among CB objectives (as stated in the law), the allocation of authority over monetary policy, procedures for conflict resolution between the CB and the government, and so forth.[17] The *LVAW* values for the first period (the 1980s) were taken from Cukierman, Webb and Neyapti (1992); for the second period (the 1990s) I use the calculated *LVAW* that were used in Cukierman, Miller and Neyapti (2002) and Sade (2003).[18]

4.2 A Preliminary Look at the Data

Table 1 – Average *LVAW* and Trade Union Density

	1980s			***1990s***		
	LVAW	***NATUD***	***TUD***	***LVAW***	***NATUD***	***TUD***
Total Average	0.353 (52)	0.335 (51)	0.429 (42)	0.600 (28)	0.407 (26)	0.459 (26)
Scandinavia	0.317 (5)	0.671 (5)	0.729 (5)	0.560 (3)	0.597 (3)	0.793 (3)
OECD (excluding Scandinavia and Japan)	0.402 (18)	0.293 (18)	0.367 (18)	0.670 (14)	0.288 (14)	0.361 (14)
Non-OECD	0.332 (28)	0.266 (27)	0.375 (18)	0.523 (11)	0.631 (9)	0.592 (9)
South and Central America	0.396 (6)	0.152 (6)	0.291 (4)	------	------	------
Asia (including Japan)	0.284 (10)	0.216 (10)	0.218 (6)	------	------	------
Africa	0.348 (6)	0.253 (6)	0.302 (2)	------	------	------

Note: Number of economies in parentheses. See also tables A.1 and A.2 in the Appendix.

The degree of the central bank independence *(LVAW)* and trade union density indices (*TUD* and *NATUD*) are presented in Tables A.1 and A.2 in the appendix. In general, the *TUD* data covers 48 various countries (42 observations in the 1980s and 26 observations in the 1990s). As for *NATUD*, the data includes 57 countries (51 observations in the 1980s and 26 observations in the 1990s).[19] Table 1,

[16] Although this index measures the legal independence of the central bank, it is quite close in its concept to Rogoff's definition of conservatism.

[17] The index *LVAW* is obtained with a two-round judgmental aggregation procedure. For further details concerning the different features of legal independence and the exact weight that was given to each feature, see section 19.3 of Cukierman (1992).

[18] Cukierman, Miller and Neyapti (2002) measure the effect that central bank independence and the degree of liberalization have on the inflation rate in economies in transition, while Sade (2003) focuses on political criteria for optimum currency areas in Europe.

[19] The sample in the 1990's includes a few economies in transition, such as, Azerbaijan, Belarus, Estonia, Slovak Rep. Slovenia and Russia.

above summarizes the different patterns that characterize different groups of countries during the two periods. As one can see, this table suggests that there is a negative link between the degree of central bank independence and unionization.[20] For instance, the (unweighted) average of *LVAW* in the Scandinavian countries (Norway, Denmark, Sweden, Iceland and Finland) is below the sample's total average, while their union density level in both indices is much higher than the sample's average in both periods. The same pattern applies with regard to OECD countries in both periods and South American countries in the 1980s as their average central bank independence is higher than the full sample's average, while the level of union density is much lower. The exception is Asia, in which both the levels of union density and central bank independence are considerably lower than in the other groups of countries. Note that comparison between the two periods would be misleading given that the panel of countries in each period is not identical.

4.3 Regression Analysis

In order to provide a statistical assessment of the hypothesis that the level of unionization has a negative effect on central bank conservatism, I estimate the following panel regressions as presented in Eq. (19):

$$(19) \quad LVAW_{j,t} = \alpha_j + \beta(Trade\,Union\,Density)_{j,t} + \sum_k \omega_k \cdot control_k + \varepsilon_{j,t} \quad j = 1,..,N; \quad t = 1,2 \quad ,$$

where the subscripts attached to the variables stand for country j and period t.

In addition to the indices of union density, I use the following dummies for control: a dummy variable for the second period (*PER90*), in which central banks generally became more independent;[21] a dummy variable for advanced economies (*OECD*);[22] a dummy variable for South and Central

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[20]Scatter figures that indicate a negative correlation between *LVAW* and the two indices of union density are shown in the appendix.

[21] One of the main reasons for high central bank conservatism in the 1990s derives from the Maastricht Treaty (1992), which laid the foundations for the EMU. One of the 5 convergence criteria for joining the EMU was an inflation rate not exceeding above 1.5% than the average of the three countries with the lowest inflation rate.

[22]The OECD members in the 1980s were: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. During the 1990s, five more countries joined the OECD. Those countries are: the Czech Rep., Hungary, Korea, Mexico and Poland.

American countries (*SCAMC*) that are characterized with relatively high legal independence but as shown in Cukierman (1992), may have low actual independence;[23] a dummy variable for former socialist economies (*FSE*), most of which chose to establish central banks with substantially high levels of independence;[24] and finally, a dummy for Japan (*JPN*), whose CB is characterized by considerably low legal independence but may have high actual independence.[25]

The actual link between central bank conservatism and level of unionization can be inferred from the coefficient of trade union density (β) in the statistical model presented above. If this coefficient is negative and significantly different from zero, the theoretical prediction about the negative relationship between central bank conservatism and union density cannot be rejected.

<u>*Estimation Method*</u>: given that the sample is quite limited and includes only two periods, the estimation is based on a random effects model (GLS estimation) that uses the "optimal combination" of within and the between variation. If the term α_j is uncorrelated with the explanatory variables $x_{j,t}$, the random effects model produces consistent and more efficient estimators than do alternative estimation methods. The basic assumption of no correlation between α_j and $x_{j,t}$ is examined by the Houseman specification test.

4.4 Estimation Results

Table 2 below shows the empirical results for the two union density indices. The Hausman specification test indicates that the random effects estimates are valid.[26] The majority of both *TUD* [Reg. (1) - Reg. (5)] and *NATUD* [Reg. (6) - Reg. (10)] coefficients are significant and negative as the theoretical model suggests. As can be seen from Table 2, the inclusion of other control variables

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[23] Cukierman (1992) shows that there are high governor-turnover rates in several countries in South and Central American countries (especially in Argentina, Costa Rica, Chile and Venezuela).

[24] The variable FSE includes: Belarus, Bulgaria, the Czech Rep., Estonia, Hungary, Poland, Romania, Slovak Rep. and Slovenia. An extensive discussion appears in Cukierman et al. (2002). See also footnote 19.

[25] Although the CB in Japan has low legal independence, monetary authorities began to adhere to an unambiguously non-accommodating rule after 1973. See Soskice and Iverson (2000).

does not change the indices' signs or significance [excluding Reg. (2)] , and they turn out to be quite stable in all of the estimated regressions (the coefficients of the trade union density indices shift between 0.1 and 0.14, in their absolute value). The possibility that the effect of union density on CB conservatism is different in different groups of countries, such the OECD and countries with very high or very low union density was also examined (by adding interaction variables); however, the interaction variables turned out to be insignificant.

Table 2. *Dependent variable: Central Bank Legal Independence (LVAW).*

Reg. number	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Intercept	0.408	0.367	0.375	0.374	0.354	0.387	0.348	0.352	0.351	0.328
	(9.92)	(7.95)	(8.27)	(8.51)	(7.95)	(12.57)	(10.53)	(10.85)	(10.88)	(9.61)
PER 90	0.269	0.262	0.257	0.228	0.233	0.269	0.257	0.253	0.236	0.240
	(9.46)	(9.76)	(9.61)	(7.62)	(7.77)	(10.00)	(9.76)	(9.61)	(7.51)	(7.65)
TUD	-0.132	-0.116	-0.129	-0.139	-0.138					
	(-1.67)	(-1.48)	(-1.67)	(-1.84)	(-1.86)					
NATUD						-0.127	-0.117	-0.124	-0.130	-0.117
						(-1.80)	(-1.72)	(-1.86)	(-1.94)	(-1.78)
OECD		0.067	0.073	0.078	0.094		0.079	0.086	0.090	0.106
		(2.00)	(2.22)	(2.42)	(2.88)		(2.65)	(2.91)	(3.02)	(3.48)
JPN			-0.232	-0.234	-0.230			-0.231	-0.233	-0.229
			(-1.78)	(-1.84)	(-1.85)			(-1.85)	(-1.88)	(-1.87)
FSE				0.101	0.105				0.049	0.053
				(2.03)	(2.12)				(1.00)	(1.10)
SCAMC					0.120					0.101
					(1.81)					(1.86)
# of Obs.	68	68	68	68	68	77	77	77	77	77
Haus. Test	0.866	0.410	0.439	0.816	0.870	0.287	0.632	0.662	0.782	0.850
R^2 *(Overall)*	0.510	0.536	0.558	0.574	0.595	0.491	0.536	0.556	0.560	0.580

Estimation: random effects model (by GLS).
* T-statistics in parentheses.

The positive coefficient of the dummy variable for the second period and its high *T* statistics indicate that there was a significantly robust change in central bank independence during the 1990s. The high

[26]The relatively high Hausman statistic values imply that there is no correlation between α_j and the explanatory variables. This conclusion suggests that the random-effects model produces unbiased estimator that are more efficient than those produced by a fixed-effects model.

LVAW during the 1990s may also have resulted from the formation of the EMU and to its convergence criteria (see footnote 21).[27] On top of the periodic effect, the estimation results show that economies in transition (ex-socialist economies) tend to establish central banks with higher independence (the dummy variable *FSE* is positive and significantly different from zero) and that OECD countries are characterized, on average, by highly independent central banks. This, however, is also the case in South and Central American countries (*SCAMC*) but in contrast to advanced economies, the central bank in these countries may have lower actual independence (see footnote 23).[28]

Estimation of the statistical model [Eq. (19)] in each period separately suggests that the negative relationship between *LVAW* and the union density indices is stronger in the second period (see Table A.3 in the appendix). In the second period (the 1990s) as well as in the two-period estimation, the coefficients of both indices were negative and significantly different from zero; their values increased (relative to the two-period estimation) and shifted between 0.2-0.25. However, in the first period, this result was found only in the regressions that contained the *TUD* index. In the *NATUD* regressions, the coefficients were negative as expected but were not significantly different from zero.

A major weakness of the analysis above arises from the fact that the trade union density indices in several countries do not entirely reflect effective collective bargaining in the economy. In particular, for Australia and a few countries in north west Europe (Germany, France, Italy, Austria, Spain, Portugal, Belgium and the Netherlands), these indices tend to underestimate the collective bargaining rate because many employees who are not defined as official union members benefit directly from collective wage agreements. As a result, the gap between the collective bargaining rate and actual

[27]For further discussion regarding the observation that many countries choose to raise their commitment to price stability, see Cukierman (1998). In order to capture the effect of globalization on *LVAW*, I have also used the binary index of "restrictions on payment for capital transactions" and the calculated indices of Quinn (1997) for capital account openness. However, these indices turned out to be insignificant.

[28]Two additional dummy variables were used in the above regressions: a dummy for the African countries that did not have any significant impact on *LVAW*, and a dummy for the Asian countries, which had a negative and significant impact on *LVAW* but was unstable and obtained only when the dummy for Japan was omitted from the model.

union density is substantially higher.[29] Because the data regarding the collective bargaining rate are very limited (available only for 19 OECD countries) and thus could not provide a sufficient basis for statistical analysis, I estimated an additional model that uses a synthetic index (*CBCR*) that incorporates the collective bargaining coverage rate data set for countries in which the data do exist, with the union density (*TUD*) data set for countries in which that data do not exist.[30] The results of the estimation are shown in Table 3.

Reg. (11) – Reg. (19) reveal that there is a negative link between the synthetic index (*CBCR*) and central banks legal independence (*LVAW*), and its impact is even higher than the impact of *TUD* and *NATUD*. However, this negative effect changes according to the level of the countries' collective bargaining rate. As those results show, in countries with considerably high levels of collective bargaining (above 90 percent), the coverage rate has a weaker impact on *LVAW* (the sum of *HIGH-CBCR* coefficients and *CBCR* coefficients is negative but smaller than the *CBCR* coefficients alone). In countries with low levels of collective bargaining (below 20 percent), the coverage rate has a stronger effect on *LVAW* (the *LOW-CBCR* coefficients are negative). This result, which is equivalent to the simulation result of the theoretical model, implies that the marginal effect of *CBCR* on *LVAW* is decreasing in the coverage rate.

An additional factor that may affect central bank legal independence is the economy's level of the openness. Higher capital-account openness increases the financial vulnerability of the economy because foreign and local investors can easily shift their investments abroad when political pressures affect central bank policy. Therefore, one might expect a positive correlation between capital-account openness and central bank independence. The indicator for capital account openness (*CAPT-OPEN)* is taken from Quinn (1997), who coded the text of the annual IMF report – *Exchange Arrangements and Exchange Restrictions* – into a five point (0-4) scale, with 4 representing a fully open economy.

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[29]According to the OECD *Employment Outlook*, 1997. An extensive discussion on the distinction between collective bargaining coverage rate and union density appears in Flanagan (1999).

[30]The data for collective bargaining coverage rates were taken from the OECD *Employment Outlook*, 1997. Because the collective bargaining coverage rate is calculated as a percentage of total salary and wage earners, the synthetic index uses only the *TUD* and not *NATUD*.

Reg. (16) – Reg. (19) revealed that this indicator is indeed positively correlated with central bank legal independence, such that the fewer the capital transactions restrictions, for the more independent the central banks. Once this variable was inserted into the regressions, it crowded out the dummies for the *OECD, FSE* and *SCAMC* but not the effect of coverage rate.

Table 3. *Dependent variable: Central Bank Legal Independence (LVAW).*

Reg. number	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*	*(19)*
Intercept	0.438	0.420	0.447	0.430	0.403	0.377	0.409	0.400	0.383
	(8.17)	(7.71)	(8.28)	(8.08)	(7.21)	(5.97)	(6.51)	(6.06)	(5.41)
PER 90	0.255	0.252	0.247	0.219	0.223	0.220	0.217	0.209	0.209
	(9.21)	9.61	(9.49)	(7.47)	(7.61)	(6.19)	(6.10)	(5.87)	(5.88)
CBCR	-0.162	-0.190	-0.234	-0.213	-0.197	-0.183	-0.221	-0.206	-0.195
	(-1.88)	(-2.20)	(-2.71)	(-2.52)	(-2.33)	(-2.10)	(-2.58)	(-2.30)	(-2.12)
LOW-CBCR	-0.902	-0.762	-0.883	-0.801	-0.644	-1.123	-1.267	-1.219	-1.152
	(-1.77)	(-1.49)	(-1.78)	(-1.65)	(-1.31)	(-2.33)	(-2.69)	(-2.51)	(-2.32)
HIGH-CBCR	0.160	0.149	0.154	0.169	0.164	0.128	0.137	0.143	0.143
	(2.56)	(2.26)	(2.43)	(2.72)	(2.67)	(2.06)	(2.30)	(2.29)	(2.27)
OECD		0.065	0.077	0.077	0.092				
		(1.84)	(2.23)	(2.28)	(2.63)				
CAPT-OPEN						0.0015	0.0015	0.0015	0.0016
						(2.06)	(2.06)	(2.01)	(2.07)
JPN			-0.286	-0.274	-0.265		-0.241	-0.235	-0.224
			(-2.20)	(-2.17)	(-2.11)		(-2.02)	(-1.92)	(-1.80)
FSE				0.098	0.103			0.054	0.059
				(1.99)	(2.10)			(0.77)	(0.83)
SCAMC					0.099				0.045
					(1.49)				(0.69)
# of Obs.	68	68	68	68	68	54	54	54	54
Haus. Test	0.545	0.530	0.651	0.849	0.911	0.923	0.907	0.315	0.328
R^2 *(Overall)*	0.546	0.566	0.597	0.610	0.624	0.613	0.643	0.641	0.644

Estimation: random effects model (by GLS).

* T-statistics in parentheses.

5. A Case Study: The United Kingdom

In order to illuminate the mechanism underlying my findings and to support the argument that this mechanism may reflect actual developments in other countries, I examined the case of the UK in some detail. Throughout the last 25 years, the evolution of unionization and the central bank conservatism in this country displays the very same pattern that the theoretical model and the empirical analysis

predict. During this period, unionization declined dramatically: union density (union members as a share of total salary and wage earners) fell from nearly 50 percent in the beginning of the 1980s to 33 percent at the end of the 1990s; more than two-thirds of this decline occurred in the 1980s. The same pattern also characterized the collective bargaining coverage rate.[31] Following this decline and the increase in labor market flexibility, legislation was passed making the Bank of England more independent. During the 1990s, the Bank conducted a more conservative monetary policy than in the previous decade.[32]

There are several explanations for the decline of unionization. Most rely on the interaction between various factors such as government policy, labor force composition, employers' actions and the macroeconomic environment. Some studies, for instance that of Freeman and Pelletier (1990), argue that legislation passed by the Thatcher government in 1980-1988, which shifted the legal balance against the unions, explains most of this decline. They find that in this period, the government's Employment Acts (1980, 1982 and 1988) - which limited strikes to the strikers' own place of work, extended the permissible grounds for refusing to join a union in a closed shop, prohibited "union work only" contractual agreements, and gave union members the right to go to work despite a strike call – considerably weakened the monopolistic power of the unions and increased the power of firms towards their employees.[33] After these changes in legislation, firms could decide whether or not to recognize a trade union and dismiss workers during industrial disputes. These changes, which were also reflected in the structure, coverage and the quality of collective bargaining, led to decentralization in wage bargaining and the collapse or reduction of many national (i.e., "multi-employer") agreements (Brown and Walsh 1991).

Other studies attribute a great part of the decline in unionization to changes in labor force composition that took place in the UK during the 1980s. According to Booth (1989), the significant reduction in the share of manufacturing industries, where the rate of unionization is relatively high, together with the

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[31] During the 1980s, the collective bargaining coverage rate decreased from 70 percent to 47 percent.

[32]The inflation rate fell from an average of 7.4 percent in the 1980s to an average of 3.7 percent in the 1990s.

[33] See Towers (1989) for a detailed discussion of the Thatcher government's legislation.

increase of the self-employed and those on temporary contracts, where the rate of unionization is relatively low, explains nearly half of the decline in union density in 1980-1986. In addition, there were some environmental effects, such as removal of exchange controls in 1979 that forced exporters and import-competing companies to improve their unit labor costs, and the end of state subsidies, particularly to monopolistic, highly unionized firms,[34] that encouraged competition in the labor market and contributed to the further reduction of union power and, as a consequence, to the reduction of the number of unionized workers.

In my view, these among other changes, eventually led the government to increase central bank conservatism (as proxied by central bank legal independence) in order to achieve better economic performance. The rise in the degree of conservatism which took place during the 1990s occurred in three separate stages. First, inflation targets were introduced at the end of 1992 as a credible anti-inflation anchor, after abandonment of the exchange rate mechanism (ERM). Second, in 1997, the government announced its intentions to transfer full operational responsibility for monetary policy to the Bank of England (BoE) by letting the BoE decide on the appropriate level of short-term interest rates necessary to meet the government's inflation targets (currently 2 percent). In addition, management of the government debt was transferred from the BoE to the Treasury. The third stage occurred in the following year (1998) as the BoE's charter was modified in the *Bank of England Act*. In the new charter, price stability was defined as the BoE's primary goal. Subject to that, the BoE had to support government objectives for growth and employment.[35]

Apparently, these changes, which increased the ability of the BoE to conduct a conservative monetary policy so as, to ensure price stability, together with the significant decline in unionization, enabled the BoE to achieve the low levels of inflation observed during the 1990s.

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[34]This applied particularly to firms in coal, steel, the automobile industry, shipbuilding and aerospace, where subsidies had reached record levels by the late 1970s.

[35]Previous charters stipulated no specific goals for the BoE.

6. Concluding Remarks

This paper analyzes a simple interaction between central banker and wage setters in both unionized and competitive sectors in order to evaluate how the level of unionization affects the socially optimal degree of central bank conservatism. The analysis suggests that there is a clear and negative relationship between the two, such that the lower the level of unionization in the economy, the higher the socially optimal degree of central bank conservatism.

This result is derived from the combination of two effects that operate when the level of unionization changes. These effects can be identified as the "competition effect" and the "strategic effect". An increase in the unionized labor force reduces competition in the labor market, and as a result, it induces the central bank to choose higher inflation in order to erode real wages ("competition effect"). Simultaneously, an increase in unionization leads to real wage moderation by the union as it desires to avoid inflation ("strategic effect"). Because this moderation will be higher the greater the weight that the central bank ascribes to unemployment stabilization, a more liberal central banker is socially preferred.

This framework also shows that at very low or very high levels of unionization, the socially optimal degree of conservatism does not have an internal solution. In one extreme case, such as very low levels of unionization, an ultra-conservative central bank is socially optimal $(I = \infty)$ as it will completely eliminate inflation without creating high unemployment. (Although this choice will lead to a rise in the real wage premium, at these low levels of unionization, this rise would have a limited impact on the total unemployment rate). In the other extreme case, such as very high levels of unionization, an ultra-liberal central bank is socially optimal $(I = 0)$ as it will minimize the loss from unemployment as well as the loss from inflation. This result, which was also obtained by Cukierman and Lippi (1999) and Guzzo and Velasco (1999), derived from the fact that once the central bank tolerates any inflation rate to maintain a stable unemployment, an inflation-averse union will reduced its real wage premium to zero. In equilibrium, both unemployment and inflation will also equal zero.

The comparative statics reveal that the socially optimal degree of conservatism will be higher the higher the union's unemployment-aversion (δ); the higher the society's distaste for inflation (S); the

greater the labor demand elasticity (α), and the lower the unions inflation aversion (γ). In cases where the union is indifferent to inflation, an ultra-conservative central banker is socially optimal.

Under certain conditions (particularly, when the union's inflation aversion is sufficiently high), the two-sector framework produces a hump-shaped relationship between the level of union density (θ) and economic variables such as the inflation rate, the real wage and unemployment (a Clamfors-Driffill hump-shaped relationship). This non-monotonic pattern stems from the fact that at low levels of unionization, where most of the labor force works in the competitive sector, the real wage clears the market; as a consequence, both unemployment and inflation are rather low. At high levels of unionization, as the central bank reaction to the nominal wage increases, the union internalizes the effect of its wage demand on the inflation rate. As a result, the wage restraint generates low inflation and low unemployment. At intermediate levels of unionization, where the reaction of the central bank to union wage determination is relatively high but union internalization is relatively moderate, unemployment and inflation will be higher. A similar result was also found in the work of Cukierman and Lippi (1999). However, unlike their multi-union framework in which the force that generates higher inflation at higher levels of centralization stems from the negative relationship between centralization and the elasticity of labor demand, in this two-sector framework, high inflation derives from the greater weight that the central bank attributes to union wage demands as the level of unionization rises. As in the Cukierman and Lippi study, when union inflation-aversion is relatively low, the resulting relationship will be monotonic as unemployment and inflation will rise with union density.[36]

Finally, the theoretical framework's prediction regarding the negative relationship between the level of unionization and central bank conservatism was examined empirically for more than 48 countries over two periods of time. For the proxy of central bank conservatism, I used the *LVAW* index of central bank legal independence; for values of the union density, I used the ILO's dataset. The estimation

[36]In Cukierman and Lippi (1999), when the union's inflation aversion is relatively low, unemployment and inflation rise with centralization.

results support the negative pattern suggested by the model as the coefficients of the alternative variables - *TUD, NATUD* and *CBCR* - were found to be negative and significantly different from zero. In addition, the regressions show that legal independence was considerably higher in the second period (the 1990s) than in the first period (the 1980s). This result can be explained by the spread of globalization in the 1990s, when governments may have used high central bank independence to signal their economies' stability to local and foreign investors, and/or by the formation of the EMU (the Maastricht Treaty, 1992) and its convergence criteria. The results also show that, on average, the legal independence of the central banks in OECD countries, ex-socialist countries and South and Central Americans countries, is substantially higher than the average of the whole estimated sample, and that higher capital-account openness is positively correlated with higher levels of central bank independence.

Appendix

A. *Proof of Proposition 3.*

Define θ_c as the level of union density, in which inflation reaches its peak (under conditions of the Calmfors-Driffill curve). The explicit expression of θ_c (since this is the union density, this expression is blocked in 1) is:

$$(A.1)\quad \frac{\partial \pi}{\partial \theta}=0;\ \frac{\partial u}{\partial \theta}=0 \ \Rightarrow\ \theta_c \equiv \frac{(I+\alpha^2)\sqrt{I\delta}}{\alpha Z+\sqrt{I\delta}};\quad \text{where}\quad Z=\sqrt{\gamma(I+\alpha^2)}\ .$$

Differentiating θ_c with respect to the central bank conservatism yields

$$(A.2)\qquad \frac{\partial \theta_c}{\partial I}=\frac{I\delta+\dfrac{\alpha\delta(I+\alpha^2)Z}{2\sqrt{I\delta}}+\dfrac{\alpha\gamma(I+\alpha^2)\sqrt{I\delta}}{2Z}}{(\alpha Z+\sqrt{I\delta})^2}>0\ .\ QED.$$

B. The second-order condition (S.O.C.) for minimization of the social loss function is

$$(B.1)\quad \frac{\partial^2 \Lambda(I)}{\partial I^2}>0 \Rightarrow \left\{I\delta[I+\alpha^2(1-\theta)]+\gamma\theta^2\alpha^2\right\}\cdot\left\{2\gamma I^2\theta^2-S\delta[I+\alpha^2(1-\theta)]\right\}>$$
$$\delta[2I+\alpha^2(1-\theta)]\left\{\delta[I+\alpha^2(1-\theta)]-\gamma\theta^2\alpha^2\right\}-I\delta\gamma\theta^2[2I+\alpha^2(1-\theta)]^2$$

C. *Proof of Proposition 4***.**

The first order condition as presented in Eq. (17) is

$$(C.1)\qquad \frac{\hat{I}}{S}=\frac{\delta[\hat{I}+\alpha^2(1-\theta)]^2-\gamma\theta^2\alpha^2}{\gamma\theta^2[2\hat{I}+\alpha^2(1-\theta)]}\ .$$

If the right side of this expression is greater than 1 for any non-negative degree of conservatism, then the socially optimal degree of conservatism is higher than that of the society. This condition is satisfied if –

$$(C.2)\qquad \delta[\hat{I}+\alpha^2(1-\theta)]^2-\gamma\theta^2\alpha^2>\gamma\theta^2[2\hat{I}+\alpha^2(1-\theta)]$$

It is easy to see that for low levels of union density, this inequality is satisfied. *QED*.

D. *Proof of Proposition 5***.**

The first-order condition as presented in Eq. (17) can be rewritten as follows:

$$(D.1)\qquad \frac{\gamma}{S}=\frac{\delta[\hat{I}+\alpha^2(1-\theta)]^2-\gamma\theta^2\alpha^2}{\hat{I}\theta^2[2\hat{I}+\alpha^2(1-\theta)]}\equiv F(\hat{I})\ .$$

$$(D.2) \qquad \frac{\partial F(\hat{I})}{\partial I} \equiv F_I = -\frac{\left[2\delta I^2\theta^2[I+\alpha^2(1-\theta)]+\alpha^2\{\delta(1-\theta)[I+\alpha^2(1-\theta)]-\gamma\theta^2\}\right]}{[2I^2\theta^2+I\alpha^2\theta^2(1-\theta)]^2}.$$

The equation above suggests that a sufficient condition for $F_I < 0$ is

$$(D.3) \qquad 2\delta I^3 \geq \alpha^2\gamma.$$

$$(D.4) \quad \frac{\partial F(\hat{I})}{\partial \theta} \equiv$$

$$F_\theta = \frac{-\delta[I+\alpha^2(1-\theta)]\left\{4I^2+\alpha^2 I\theta+2\alpha^2 I[1+2(1-\theta)]+2\alpha^4\theta(1-\theta)\right\}-\gamma\theta^3\alpha^4}{I\theta^3[2I+\alpha^2(1-\theta)]^2} < 0.$$

i. Given the negative effect that both central bank conservatism, *I*, and union density, θ, have on *F(I)*, an increase in θ must reduce *I* in order to maintain the equality of the F.O.C.

$$(D.5) \quad \frac{\partial \hat{I}}{\partial \theta} = -\frac{F_\theta(\hat{I})<0}{F_I(\hat{I})<0} < 0. \quad QED.$$

E. *Proof of Proposition 6***.**

ii. An increase in union inflation aversion (γ) increases the left side of Eq. (*D.1*) and decreases the right side of the same equation. For a negative F_I, the level of optimal conservatism must decrease in order to maintain the equality of the F.O.C. Therefore, a negative relationship holds between γ and $\hat{I}$. *QED*.

iii. An increase in union unemployment aversion (δ) increases the right side of Eq. (D.1), while the left side remains constant. In order to maintain the equality of the first order condition, the level of optimal conservatism must increase (for a negative F_I). *QED*.

iv. An increase in society's distaste for inflation reduces the left side of the F.O.C, while the right side is constant. In order to maintain the equality of the first order condition, the level of the optimal conservatism must increase as well (for a negative F_I). *QED*.

Figure A.1 - Socially Optimal Conservatism

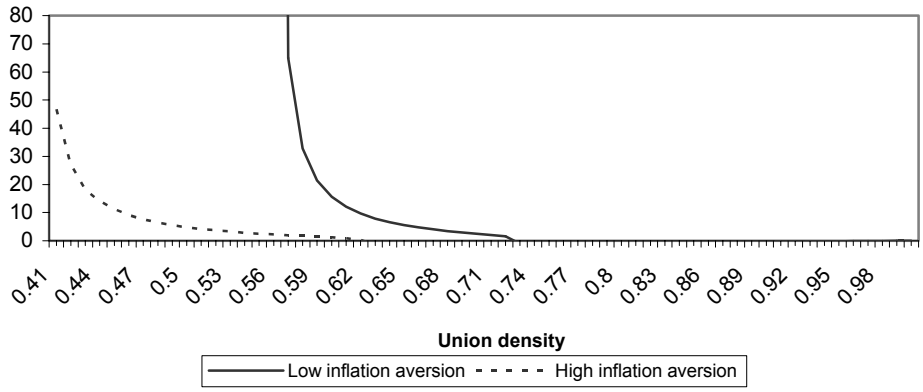


Figure A.2 - Socially Optimal Conservatism

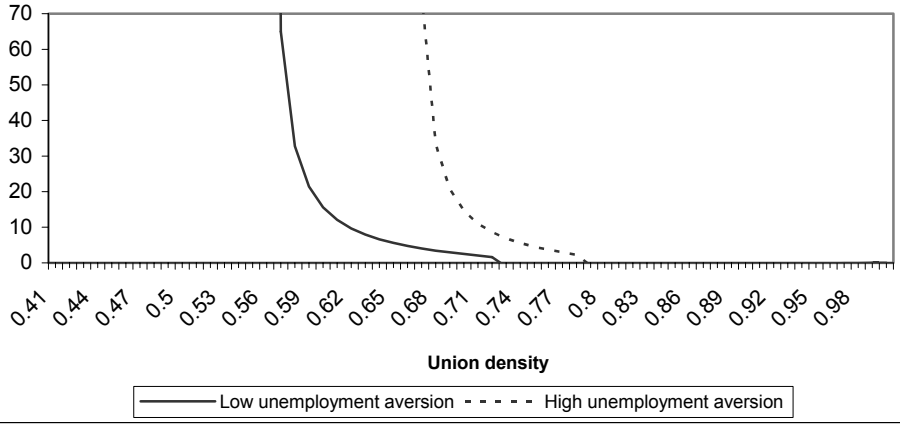
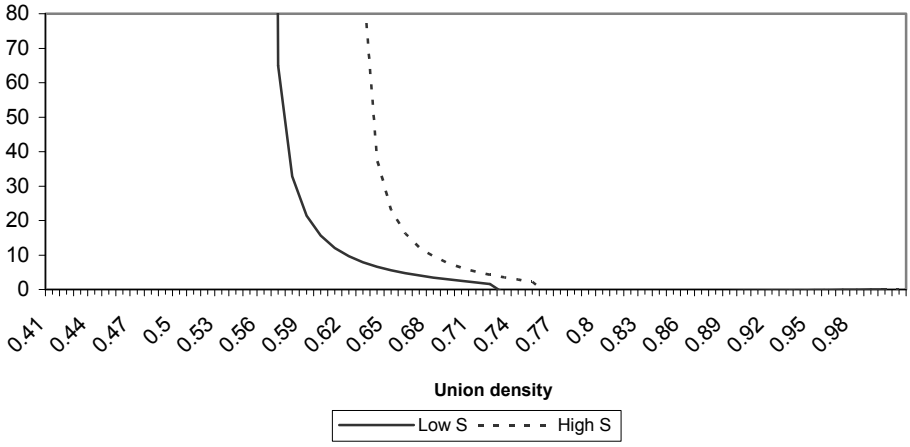


Figure A.3 - Socially Optimal Conservatism



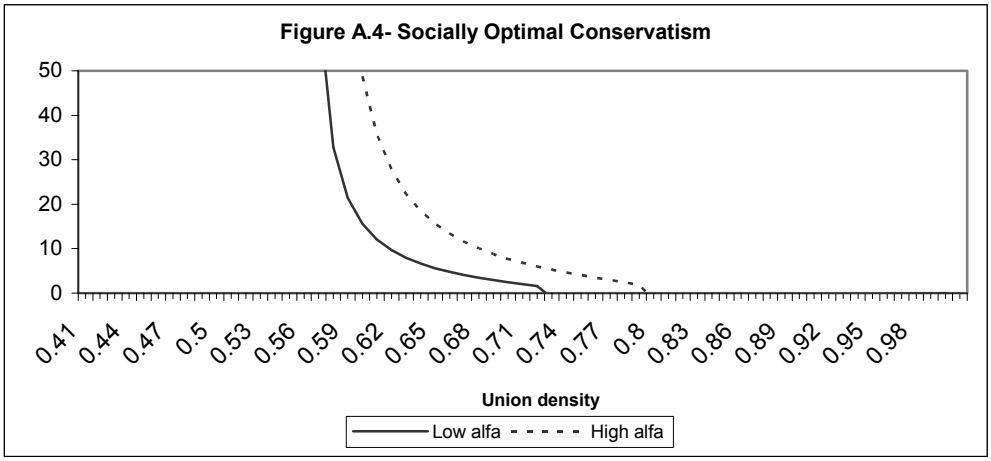


Figure A.4- Socially Optimal Conservatism
50
40
30
20
10
0
0.41
0.44
0.47
0.5
0.53
0.56
0.59
0.62
0.65
0.68
0.71
0.74
0.77
0.8
0.83
0.86
0.89
0.92
0.95
0.98
Union density
Low alfa
High alfa

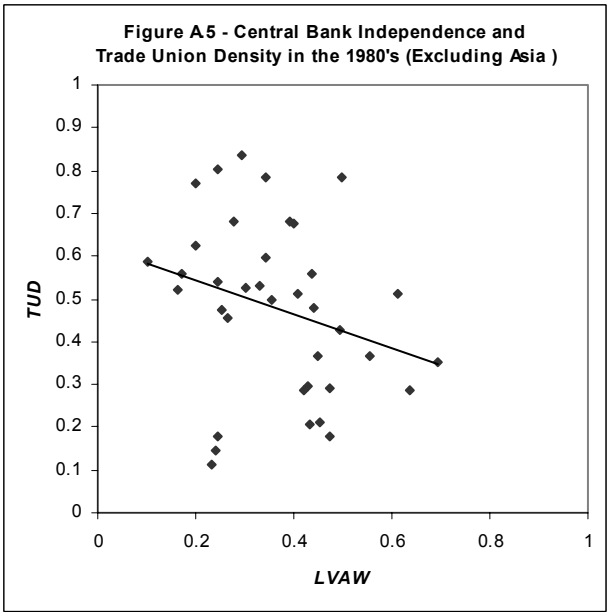


Figure A.5 - Central Bank Independence and Trade Union Density in the 1980's (Excluding Asia)
TUD
LVAW

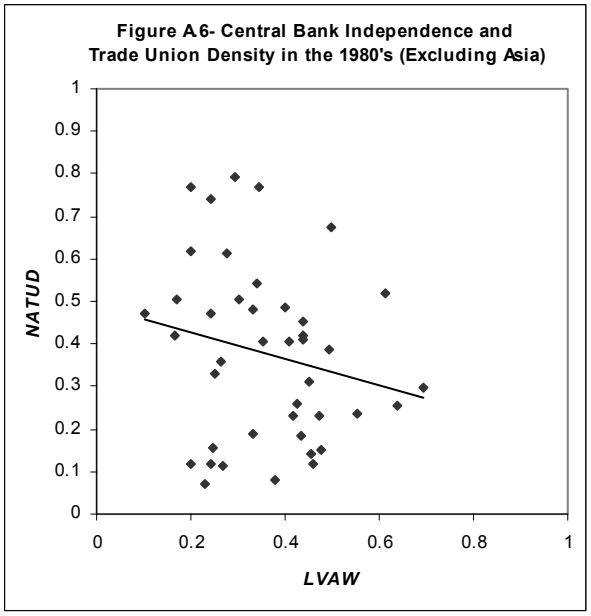


Figure A.6- Central Bank Independence and Trade Union Density in the 1980's (Excluding Asia)
NATUD
LVAW

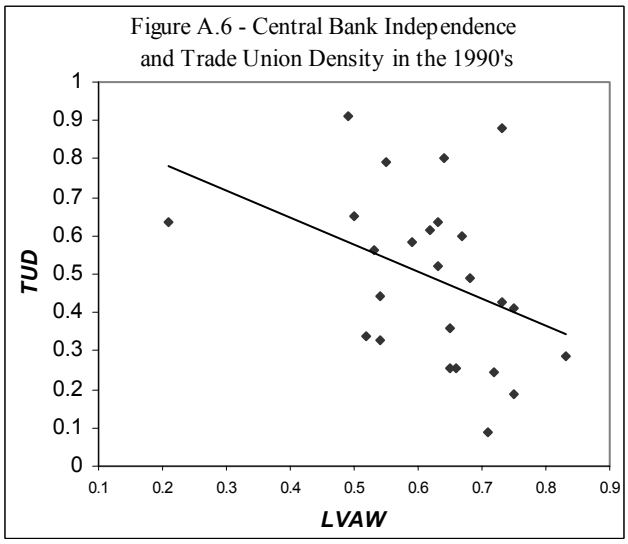


Figure A.6 - Central Bank Independence and Trade Union Density in the 1990's
TUD
LVAW

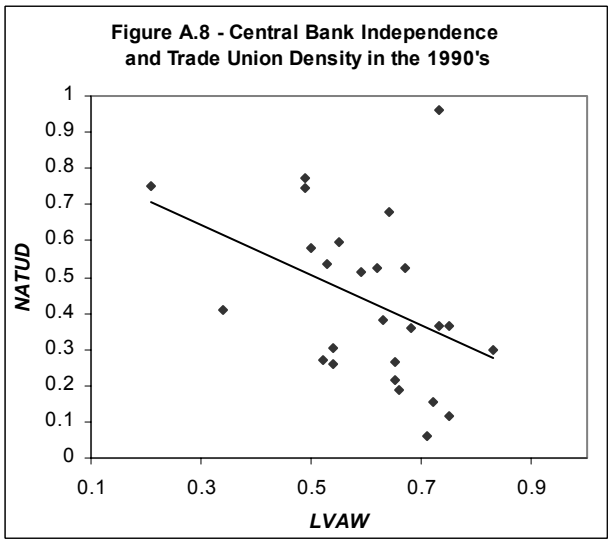


Figure A.8 - Central Bank Independence and Trade Union Density in the 1990's
NATUD
LVAW

Table A.1 – Trade Union Density and Legal Independence of Central Banks, 1980s

State	*LVAW*	*NATUD*	*TUD*	*State*	*LVAW*	*NATUD*	*TUD*
Argentina	0.400	0.487[b]	0.674[b]	*Malta*	0.440	0.455	0.479
Australia	0.355	0.406	0.500	*Malaysia*	0.360	0.135[b]	NA
Austria	0.614	0.517	0.510	*Mexico*	0.342	0.541[e]	0.596[e]
Belgium	0.165	0.420	0.520	*Netherlands*	0.419	0.233	0.287
Bulgaria	0.201[i]	0.619[f]	0.623[f]	*New Zealand*	0.243	0.471[b]	0.541[b]
Canada	0.451	0.312	0.367	*Norway*	0.170	0.507	0.557
Chile	0.460	0.116	NA	*Pakistan*	0.210	0.064[c]	NA
China	0.290	0.594	NA	*Philippines*	0.433	0.184	0.207
Colombia	0.270	0.112	NA	*Poland*	0.104	0.471[e]	0.588[e]
Costa Rica	0.474	0.229	0.291	*Portugal*	0.410	0.406[b]	0.514[b]
Czech Rep.	0.201[i]	0.768[f]	0.769	*Romania*	0.304	0.507[f]	0.528[f]
Denmark	0.498	0.674	0.783	*Singapore*	0.292	0.170	0.194[a]
Egypt	0.493	0.389	0.427	*South Africa*	0.246	0.155	0.177
Finland	0.276	0.614	0.683	*South Korea*	0.264	0.086	0.124
France	0.241	0.116	0.145	*Spain*	0.231	0.073	0.115
Germany	0.695	0.295[h]	0.353[h]	*Sweden*	0.295	0.793	0.838
Greece	0.555	0.235	0.367	*Switzerland*	0.638	0.254	0.288
Hungary	0.243	0.741	0.804	*Taiwan*	0.210	0.302[c]	0.429
Iceland	0.344	0.767	0.783	*Thailand*	0.265	0.033	0.043
India	0.340	0.060[g]	NA	*Turkey*	0.455	0.141[c]	0.210[c]
Ireland	0.437	0.410	0.560	*Uganda*	0.380	0.078[e]	NA
Israel	0.425	NA	0.690[d]	*United Kingdom*	0.265	0.360	0.455
Italy	0.252	0.329	0.476	*United States*	0.475	0.150	0.180
Japan	0.179	0.226	0.288	*Venezuela*	0.427	0.259[d]	0.298[d]
Kenya	0.440	0.419	NA	*Zambia*	0.330	0.188	NA
Luxemburg	0.331	0.480[c]	0.530[c]	*Zimbabwe*	0.200	0.116	NA

Note: The variables *TUD* and *NATUD* refer to 1985. The *LVAW* index refers to the period 1980-1989.
[a] 1984; [b] 1986; [c] 1987; [d] 1988; [e] 1989; [f] 1990; [g] Average of 1980 and 1991; [h] West Germany; [i] A proxy based on the average CBI of the Central-Eastern Europe socialist economies during the 1980's (Poland, Hungary, Romania and Yugoslavia).

Source: Union membership as a percentage of wage and salary earners (*TUD*) and as a percentage of the non-agricultural labor force (*NATUD)* was taken from the *World Labor Report 1997-1998*, ILO; *TUD* of Israel is taken from Cohen et al. (2003).The values for legal central bank independence (*LVAW*) were taken from Cukierman et al. (1992).

Table A.2 – Trade Union Density and Legal Independence of Central Banks, 1990s

State	*LVAW*	*NATUD*	*TUD*	*State*	*LVAW*	*NATUD*	*TUD*
Austria	0.750	0.366	0.412	*Ireland*	0.680	0.360	0.489
Azerbaijan	0.210	0.754	0.638	*Italy*	0.540	0.306	0.441
Belarus	0.730	0.961	0.880	*Israel*	0.460	NA	0.450[b]
Belgium	0.630	0.381	0.519	*Malta*	0.500	0.579[b]	0.651[b]
Bulgaria	0.590	0.514[a]	0.582[a]	*Netherlands*	0.650	0.218	0.256
Cyprus	0.530	0.537	0.565	*Poland*	0.520	0.270	0.338
Czech Rep.	0.730	0.363	0.428	*Portugal*	0.660	0.188	0.256
Denmark	0.640	0.682[b]	0.801[b]	*Romania*	0.340	0.407[a]	NA
Estonia	0.650	0.264	0.361	*Russia*	0.490	0.748	NA
Finland	0.550	0.597	0.793	*Slovak Rep.*	0.620	0.523	0.617
France	0.710	0.061	0.091	*Slovenia*	0.630	NA	0.635
Germany	0.830	0.296	0.289	*Spain*	0.750	0.114[b]	0.186[b]
Greece	0.720	0.154	0.243	*Sweden*	0.490	0.772[b]	0.911[b]
Hungary	0.670	0.525	0.600	*United Kingdom*	0.540	0.262	0.329

Note: The variables *TUD* and *NATUD* refer to 1995. The *LVAW* index refers to the period 1990-1998.
[a] 1993; [b] 1994;
Source: Union membership as a percentage of wage and salary earners (*TUD*) and as a percentage of the non-agricultural labor force (*NATUD*) was taken from the *World Labor Report 1997-98*, ILO. *TUD* of Slovenia is taken from the *Slovenian Economic Mirror 96*; *TUD* of Israel is taken from Cohen et al. (2003). The values for legal central bank independence (*LVAW*) were taken from Cukierman et al. (2002), Cukierman (2003) and Sade (2003).

Table A.3. *Dependent variable: Central Bank Independence (LVAW).*

	1980s				***1990s***			
Reg. number	(A.1)	(A.2)	(A.3)	(A.4)	(A.5)	(A.6)	(A.7)	(A.8)
Intercept	0.455	0.440	0.404	0.383	0.719	0.713	0.709	0.708
	(7.90)	(6.69)	(10.13)	(8.62)	(12.27)	(12.27)	(13.29)	(12.91)
TUD	-0.187	-0.183			-0.213	-0.240		
	(-1.71)	(-1.65)			(-1.95)	(-2.18)		
NATUD			-0.115	-0.121			-0.243	-0.250
			(-1.27)	(-1.33)			(-2.22)	(-2.16)
ASIA	-0.141	-0.130	-0.098	-0.080				
	(-2.15)	(-1.87)	(-2.04)	(-1.58)				
OECD		0.021		0.041				
		(0.49))		(1.08)				
FSE						0.062		0.012
						(1.23)		(0.23)
# of Obs.	42	42	51	51	26	26	26	26
Adj-R^2	0.074	0.056	0.047	0.050	0.100	0.119	0.135	0.099

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