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Document de Travail n° 2020 – 26

*Mai 2020*

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# Monetary policy with weakened unions\*

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May 20, 2020

**Abstract:** We assess the impact of union bargaining power on inflation and employment in the case of efficiency bargaining following Mac Donald & Solow (1981). We consider a Stackelberg two-stage game between the Central Bank and social partners (firms and union). Firms and unions negotiate employment and nominal wage, the Central Bank sets the inflation rate. We show that a decrease in union bargaining power tends to reduce nominal wage and employment. In such a context, where the Central Bank is concerned with inflation and employment, the optimal monetary policy consists in a stronger stabilization of employment at the expense of inflation stabilization. We then employ a panel data model for 36 OECD countries to empirically assess the link between the bargaining power of unions and inflation. Our estimates confirm this theoretical result by showing that a low degree of union bargaining power is associated with higher inflation.

**Keywords :** monetary policy, employment, inflation, wage setting, union bargaining power, efficiency bargaining, conservatism

**JEL classification :** E02, E24, E52, E58, J51

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\*This paper received support from the Excellence Initiative of the University of Strasbourg funded by the French Government's Future Investments Program.

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# 1 Introduction

Since fifteen years, we observe changes in central banks behavior. Indeed, while the Volker era lied on a strong fight against inflation during the 80's, central banks recently seem to become less conservative. It can not be denied that the Great Crisis has played a crucial role to explain lower inflation aversion of central banks. However, another argument which could justify this trend may be labor market flexibilization, which leads to downward pressures on wages. As underlined by Venn (2009), collective bargaining has played an important role for many years in OECD countries labor markets. So, the increase in labor market competition has notably been reached by a fading union bargaining power. Hence, for a better understanding of the interactions between monetary policy and labor market, it is crucial to introduce the labor institutional environment. In particular, it seems relevant to take into account the presence of unions and bargaining process between social partners (firms and unions).

A very extensive literature has focused on the relationship between monetary policy and negotiations with social partners. In their seminal paper, Calfors & Driffill (1988) introduce the degree of centralization of wage setting and analyze its effect on inflation. They show that, in the case of unions operating at the individual firm or plant level, effects of bargaining on inflation are small. On the contrary, when unions bargain at an intermediate level, effects of negotiation on inflation are maximal. Cukierman & Lippi (1999)<sup>1</sup> consider a game between a monetary authority and a union to evaluate the effects of both the degree of Central Bank conservatism and the degree of wage bargaining centralization on macroeconomic outcomes. They reach the same conclusion concerning the relation between the degree of wage bargaining centralization and the level of inflation, which follows a U-shaped curve. They also find that the Central Bank's independence positively affects inflation if unions are adverse to inflation. In the same vein, Holden (2005) argues that an accommodating monetary regime may reduce equilibrium unemployment, by strengthening the wage setters' incentives to coordinate. Acocella, Di Bartolomeo & Hibbs (2008) also focus on effects of wage formation regime on the efficiency of monetary policy with regard to real economy. Their analysis emphasizes that the posture of monetary policy towards inflation influences the strategic calculations driving unions' wage setting behavior in different institutional environments. In a nutshell, all of these papers highlight the crucial role of two key parameters: the degree of conservatism of the Central

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<sup>1</sup>See also Grüner & Hefeker (1999), Guzzo & Velasco (1999), Cukierman & Lippi (2001), Lawler (2001), Diana & Zimmer (2005) and Sidiropoulos & Zimmer (2009).

Bank and the degree of centralization of collective bargaining.

However, despite the abundance of studies on this subject, two important dimensions of the strategic game between monetary authority and social partners are neglected. First, these analysis consider the particular framework of monopoly unions. We must recall that the case where bargaining power entirely belongs to union alone is a special case of collective bargaining. The general case in which the bargaining power is shared between firms and unions could offer a more relevant description. Secondly, most of these papers assume that the Central Bank plays as a follower in the strategic games with unions. Nevertheless, as shown by Blanchard & Galí (2010) and Faia & Rossi (2013), the presence of labor market institutions, and more generally the labor market functioning, affect the trade-off faced by the Central Bank between inflation and unemployment stabilization. It seems appropriate to assume that monetary authority has to take into consideration the labor market's functioning in its optimal policy decision.

This article attempts to fill these gaps. The added value of this analysis is twofold. First, concerning unions, we do not take into account the degree of wage bargaining centralization.<sup>2</sup> Indeed, as underlined by Feldmann (2011), the monetary strategy of an independent Central Bank does not depend on the level of wage negotiation. Moreover, we do not consider a monopoly union. We explicitly take into consideration an optimal bargaining process following Mac Donald & Solow (1981). In this microfounded framework, firms and unions share the bargaining power and determine together nominal wage and employment. Secondly, we explicitly consider the strategic interactions between the monetary authority and social partners. In the case of a sequential decision game, where the Central Bank plays as a leader, the optimal monetary policy will be affected by the behavior of social partners.

More precisely, we consider an economy composed of firms, a single union and a monetary authority. Firms and the union negotiate employment and nominal wage. The Central Bank sets the inflation rate. In this framework, our main objective is to identify the impact of union bargaining power on inflation and employment. Indeed, empirical studies show that union bargaining power tends to decrease for different reasons. For instance, Boniface (2014) underlines in a survey that globalization reduces the union bargaining power due to increasing competition from low-wage countries. Hirsch & Schnabel (2011) argue that the unions are less powerful because the share

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<sup>2</sup>For a study on the impact of union density on inflation, see for instance Bowdler & Nunziata (2007).

of employment is reduced in favor of capital. Moreover, the high level of unemployment in Europe could also be explained by this phenomenon, as highlighted by Jaumotte & Osorio Buitron (2015).

We show that a decrease in union bargaining power tends to reduce nominal wage and employment. In such a context where the Central Bank is concerned with inflation and employment, the optimal monetary policy consists in a stronger stabilization of employment at the expense of inflation stabilization. Moreover, we demonstrate that these impacts are even more important when the Central Bank is highly conservative. In addition, we provide empirical evidence on relation between bargaining power and level of inflation. We use a panel data model for 36 OECD countries with annual data from 1980 to 2015. We find that a weak union bargaining power is significantly associated with higher inflation.

As a consequence, the monetary policy conducted by most of central banks in OECD countries since the 2008 crisis could partially be explained by the weakening of union bargaining power. In other words, the negative effects of structural measures that reduce union bargaining power could be offset by cyclical monetary policy of employment stabilization.

The rest of the paper is organized as follows. Section 2 presents the analytical framework. Section 3 describes inflation and employment at equilibrium in this economy. Section 4 analyses the macroeconomic consequences of a change in union bargaining power. Section 5 proposes the econometric approach. Finally, we conclude in section 6.

## 2 Framework

We consider a closed economy composed of firms, a single union and a monetary authority.<sup>3</sup> For simplicity's sake, a fiscal authority is not introduced into this framework. Although this assumption is restrictive, it allows us to consider a three-player game, making it possible to understand the underlying mechanisms at work. The union and firms negotiate employment and nominal wage, and the Central Bank sets the inflation rate. More precisely, the game between these actors is a Stackelberg two-stage game in which the

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<sup>3</sup>See Daniels, Nourzad & VanHoose (2006) for an analysis of monetary policy with unions in the case of an open economy.

Central Bank plays as leader, and union and firms play as followers. Contrary to standard literature<sup>4</sup>, we assume here that the monetary authority is not a follower. Indeed, in this standard literature, collective bargaining usually takes place in a special case of monopoly unions, where union bargaining power is constant. In our framework, we consider a more general case, where the bargaining power is shared between social partners and can change. In this context, the bargaining power becomes a key parameter for monetary policy, as highlighted by Blanchard & Galí (2010) and Faia & Rossi (2013). It appears relevant to specify that the Central Bank will integrate the strategic interaction between firms and union in its optimal decision, by playing as leader.

In the first stage of this game, the Central Bank minimizes its loss function with regard to the inflation rate, knowing the nominal wage and level of employment at the negotiated equilibrium between union and firms. In the second stage, firms and union bargain employment and nominal wage, considering as given the expected level of prices. Once the Central Bank determines the optimal inflation rate, the negotiated equilibrium is fully determined. As in any game with sequential decisions, the resolution is backwards. From then on, we first have to express the bargaining process between firms and union. Then, we will be able to introduce these results into the Central Bank optimization program. This section aims at presenting the behavior of each economic agent in this economy.

## 2.1 Firms, union and optimal bargaining process

In this economy, we assume that the union represents the interests of all workers (both employees and unemployed) whose population amounts to  $\bar{L} = 1$ . The objective of the union is to maximize the sum of utilities of all its members. Notice that the utility function of a worker is given by  $v(R_t) = R_t^\beta$ , where  $R_t$  represents the real revenue, and  $\beta < 1$ , meaning that workers are risk-averse. The real revenue corresponds to the real wage  $W_t/P_t$  for employee and to  $\bar{W}/P_t$  for unemployed worker, where  $\bar{W}$  is the nominal unemployment benefit,<sup>5</sup> assumed to be fixed and  $P_t$  the general level of prices

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<sup>4</sup>See for example Lawler (2001), Berger, Hefeker & Schöb (2004), Holden (2005) or Guzzo & Velasco (1999).

<sup>5</sup>Here, we leave fiscal authority out in this analysis. As a consequence, we do not take into account the financing of unemployment benefit, the latter is so considered as given.

at period  $t$ . Consequently, the objective function  $V_t$  of the union is given by:<sup>6</sup>

$$V_t = L_t \left[ \left( \frac{W_t}{P_t} \right)^\beta - \left( \frac{\bar{W}}{P_t} \right)^\beta \right] \quad (1)$$

where  $L_t$  stands for the level of employment. This equation means that the union's concern is twofold: it cares about the employment level of its members and about the surplus of employees with respect to an unemployed worker.

On the supply side, production  $Y_t$  of the representative firm is given by the following function with  $\alpha \in (0, 1)$  the technology parameter:

$$Y_t = L_t^\alpha \quad (2)$$

The objective of the firm is to maximize its real profit  $\Psi_t$  given by:

$$\Psi_t = L_t^\alpha - \frac{W_t}{P_t} L_t \quad (3)$$

In this economy, we consider that collective bargaining takes place in an efficient negotiation process.<sup>7</sup> Unlike right-to-manage bargaining, where unions bargain with firms only over wages, in efficiency bargaining, social partners negotiate wages and employment. Indeed, other considerations than wages can also be taken into account in collective bargaining, such as working time, employment, working conditions...

As the union and firms determine together the nominal wage and the level of employment in the economy following Mac Donald & Solow (1981), the outcome of the bargaining process is the solution of the maximization of the expected generalized Nash bargaining function  $S_t$ , with respect to the nominal wage  $W_t$  and the level of employment  $L_t$ :

$$\max_{(W_t, L_t)} E_{t-1}[S_t] = E_{t-1} \left[ \left\{ L_t \left[ \left( \frac{W_t}{P_t} \right)^\beta - \left( \frac{\bar{W}}{P_t} \right)^\beta \right] \right\}^\gamma \left\{ L_t^\alpha - \frac{W_t}{P_t} L_t \right\}^{1-\gamma} \right] \quad (4)$$

where  $E_{t-1}$  denotes the expectations operator and  $\gamma \in (0, 1)$  represents the bargaining power of the union. In other words, this Nash bargaining function takes into account both the surplus of all workers and the real profit of

<sup>6</sup>Notice that since the union maximizes the utility of both employees and unemployed workers, the original objective function can be written

$\tilde{V}_t = L_t (W_t/P_t)^\beta + (\bar{L} - L_t) (\bar{W}/P_t)^\beta$ . In other words,  $\tilde{V}_t = V_t + \bar{L} (\bar{W}/P_t)^\beta$ . Since  $\bar{L} (\bar{W}/P_t)^\beta$  is given for the union, maximizing  $V_t$  equals maximizing  $\tilde{V}_t$ .

<sup>7</sup>See Cahuc, Carcillo & Zylberberg (2014) or Layard, Nickell & Jackman (2005) for a description of the main models of collective bargaining, namely simple union monopoly, wage-bargaining (or right-to-manage), efficient bargaining and insider-outsider models.

firms. In the extreme case where  $\gamma = 0$ , the model becomes a simple competitive labor market. The other extreme case, where  $\gamma = 1$ , corresponds to a monopoly-union model, in which the union decides alone both the level of employment and nominal wage.<sup>8</sup>

From the first order conditions of this optimization program, we obtain the bargained level of nominal wage  $W_t^B$  and employment  $L_t^B$ :

$$W_t^B = \left( \frac{\alpha + \gamma(1 - \alpha)}{\alpha + \gamma(1 - \alpha)(1 - \beta)} \right)^{\frac{1}{\beta}} \bar{W} \quad (5)$$

$$L_t^B = \left( \frac{[\alpha + \gamma(1 - \alpha)]^{1-\beta}}{\alpha + \gamma(1 - \alpha)(1 - \beta)} \right)^{\frac{1}{\beta(\alpha-1)}} \left( \frac{\bar{W}}{P_t^e} \right)^{\frac{1}{\alpha-1}} \quad (6)$$

where  $P_t^e$  is the expected level of prices in  $t - 1$  for period  $t$ .

The bargained nominal wage given by relation (5) is obviously higher than the unemployment benefit ( $W_t^B > \bar{W}$ ), as the aim of the union is to maximize the surplus of employees. Unsurprisingly, given the Cobb-Douglas functions (utility and production), the relation between  $W_t^B$  and  $\bar{W}$  is linear. In other words, the more generous the unemployment benefit, the higher the bargained nominal wage. Furthermore, a higher nominal unemployment benefit induces a lower level of optimal employment ( $dL_t^B/d\bar{W} < 0$ ). Indeed, *ceteris paribus*, a rise in  $\bar{W}$  implies a positive variation in the bargained wage  $W_t^B$  which in turn reduces the bargained employment  $L_t^B$ .

After having analyzed effects of unemployment benefit on bargained variables, we turn now to the study of the impact of a modification of union power on the nominal wage and employment. It is straightforward to see that strengthening of union power (a higher  $\gamma$ ) leads to higher employment ( $dL_t^B/d\gamma > 0$ ) and nominal wage level ( $dW_t^B/d\gamma > 0$ ). Indeed, recalling that the negotiation process relies on efficiency bargaining (both nominal wage and employment are discussed between social partners), a higher union bargaining power means a greater weight given to the union objective in the negotiation function (equation (4)). Thus, it increases the focus both on the gap between wage and unemployment benefit and on the level on employment, as the union also cares about employment.<sup>9</sup> In this context, this

<sup>8</sup>In this framework, the bargaining power is supposed exogenous, explained for instance by the international concurrence. Indeed, in this paper, we do not focus on the determinants of union power. See Board & Zwiebel (2012) for the study on endogenous union bargaining power.

<sup>9</sup>From the first order conditions, we obtain the standard contract curve of the efficiency bargaining model, leading to an increasing relation between employment and nominal wage:  $L_t^B = \left[ \frac{1}{\alpha\beta P_t^e} ((\beta - 1)W_t^B + \bar{W}^\beta (W_t^B)(1 - \beta)) \right]^{\frac{1}{\alpha-1}}$  with  $dL_t^B/W_t^B > 0$ .



increasing union bargaining power implies a rise in both nominal wage and employment.

Finally, it is important to underline the effects of the expected general level of prices on the bargained variables. Indeed, given that the general level of prices is of crucial importance for the Central Bank, it is relevant to assess its impact on the negotiation process. It appears that the bargained level of employment is negatively correlated to the expected level of prices. More precisely, as shown by relation (6), a larger expected general level of prices yields a lower real unemployment benefit, leading to a rise in employment. Nevertheless, expected prices do not affect the level of the negotiated wage. The latter result can be explained by the specific objective function of union  $V_t$ , which focuses on the surplus of employed workers, leading to a linear relation between bargained wage and unemployment benefit. In this case, considering real or nominal revenue does not affect the gap, as shown by relation (5).

## 2.2 The Central Bank

In this economy, the Central Bank has two objectives: the stabilisation of both inflation and unemployment.<sup>10</sup> As a consequence, and following Kydland & Prescott (1977), Barro & Gordon (1983) and Clarida, Gali & Gertler (1999), its preferences can be expressed by a quadratic loss function  $\Gamma_t$  given by:

$$\Gamma_t = \frac{1}{2} [U_t^2 + I\Pi_t^2] \quad (7)$$

where  $U_t$  and  $\Pi_t$  respectively represent unemployment and inflation rates.  $I > 0$  corresponds to the relative Central Bank preference for inflation stabilization which captures its degree of conservatism.<sup>11</sup>

The monetary authority optimizes its objective function, with respect to the inflation rate, knowing the levels of bargaining employment and nominal

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<sup>10</sup>As shown by Holden (2004), there exists a trade-off between inflation and employment in most European countries.

<sup>11</sup>A distinction between conservatism and independence was first underlined by Lohmann (1992), Cukierman (1994) and Lippi (2000). Conservatism takes into consideration the relative preferences of the central bank for inflation stabilization, whereas independence describes its ability to conduct policy so as to attain these objectives. As we mainly focus on central bank's aversion for inflation, the term conservatism is used in the remainder of this paper.

wage. The program of the Central Bank can be expressed as follows:

$$\left\{ \begin{array}{l} \min_{\Pi_t} \Gamma_t = \frac{1}{2} [U_t^2 + I\Pi_t^2] \\ \text{st } W_t^B = \left( \frac{\alpha + \gamma(1 - \alpha)}{\alpha + \gamma(1 - \alpha)(1 - \beta)} \right)^{\frac{1}{\beta}} \bar{W} \\ L_t^B = \left( \frac{[\alpha + \gamma(1 - \alpha)]^{1-\beta}}{\alpha + \gamma(1 - \alpha)(1 - \beta)} \right)^{\frac{1}{\beta(\alpha-1)}} \left( \frac{\bar{W}}{P_t^e} \right)^{\frac{1}{\alpha-1}} \end{array} \right. \quad (8)$$

Notice that  $U_t = -\ln L_t = -l_t \geq 0$ ,<sup>12</sup> with  $l_t$  the logarithm of employment given by the following expression, with  $\bar{w} = \ln \bar{W}$ :

$$l_t = \ln B - \frac{1}{1 - \alpha} (\bar{w} - \Pi_t - p_{t-1}) \quad (9)$$

where

$$B(\gamma) = \left( \frac{[\alpha + \gamma(1 - \alpha)]^{1-\beta}}{\alpha + \gamma(1 - \alpha)(1 - \beta)} \right)^{\frac{1}{\beta(\alpha-1)}}, \text{ with } B'(\gamma) > 0 \quad (10)$$

### 3 Inflation and employment at the equilibrium

To characterize the equilibrium of the economy, we first compute the optimal level of inflation determined by the Central Bank. Then, we introduce this result into the bargained level of employment, as the negotiated nominal wage does not depend on inflation.

The resolution of the Central Bank's program (8) leads to the following optimal inflation rate:

$$\Pi_t^* = \frac{-(1 - \alpha) \ln B + (\bar{w} - p_{t-1})}{1 + I(1 - \alpha)^2} \quad (11)$$

The optimal inflation rate depends on several variables, including the degree of conservatism ( $I$ ), the (log of) nominal unemployment benefit ( $\bar{w}$ ) and the level of prices in the previous period ( $p_{t-1}$ ).

We obtain a traditional result in this literature: the more independent the Central Bank (when  $I$  is higher), the lower the optimal inflation rate.

<sup>12</sup>Indeed,  $U_t = (\bar{L} - L_t)/\bar{L}$ , with  $\bar{L} = 1$ , which leads to  $L_t = 1 - U_t$ . Through the logarithm form, we obtain :  $\ln(1 - U_t) \simeq -U_t = \ln L_t = l_t$ .

Moreover, we show that the optimal inflation rate decreases with the level of prices in the previous period  $p_{t-1}$ . Indeed, when previous prices are relatively high, the real cost of labor is low and as a consequence, unemployment is contained. In this context of low unemployment, the Central Bank can afford to fight inflation more actively.

Finally, in this original framework where the bargaining process is explicitly considered, we must underline the major role played by the unemployment benefit in the Central bank behavior. Indeed, the optimal inflation rate increases with unemployment benefit  $\bar{w}$ . As shown by the objective function of the monetary authority (equation (7)), the Central Bank is also concerned by the stabilization of unemployment. Through relations (5) and (6), we know that the bargained level of employment decreases with this benefit. Recalling that the optimal bargaining process concerns notably the surplus of employees with respect to unemployed workers, a higher unemployment benefit leads the union to claim higher nominal wage, implying a lower level of bargained employment. In this context, in order to avoid an increase in unemployment, the Central Bank has to set a higher level of inflation, in order to reduce the real wage, thereby allowing a higher level of employment. In others words, the Central Bank is able to offset the negative impact on employment of a higher unemployment benefit.

Knowing the optimal level of the inflation rate, we can now compute the level of employment at equilibrium. Introducing relation (11) into the negotiated employment (9), we obtain:

$$l_t^* = \frac{I(1-\alpha)^2}{1+I(1-\alpha)^2} \left( \ln B - \frac{1}{1-\alpha}(\bar{w} - p_{t-1}) \right) \quad (12)$$

The equilibrium level of employment decreases with the unemployment benefit. Indeed, as underlined above (see equations (5) and (6)), the bargained equilibrium relies on the unemployment benefit. A higher unemployment allowance leads to a higher bargained wage and lower employment. These effects are still observed after introducing the optimal behavior of the Central Bank.

The impact of the previous price level  $p_{t-1}$  on employment is more complex, and the behavior of the Central Bank plays a crucial role. We can notice that an increase in previous price leads to a reduction of unemployment. To understand this effect, it is important to shed light on the relation between the current price level  $p_t$ , the previous price level  $p_{t-1}$  and the inflation rate

$\Pi_t$ . Knowing that  $\Pi_t = p_t - p_{t-1}$ , the relation (11) shows a positive correlation between current and past price levels. As a consequence, an increase in the previous price level tends to raise the current prices, and therefore reduces the real bargained wage. This drop has a positive impact on employment.

Until now, we have not discussed the effect of union bargaining power on equilibrium. This will be the object of the next section, where these latter consequences will notably depend on the Central Bank's degree of conservatism.

## 4 Impact of union bargaining power

In this economy, as shown previously, we have considered the case of efficient bargaining. The outcome of the negotiation depends heavily on union bargaining power measured by  $\gamma$ . The objective of this section is to analyze its influence on employment, wage and inflation, at equilibrium, summarized by relations (12), (5) and (11). In a strategic game, any change in a player's behavior parameters induces a change in the behavior of the other players. In this particular game, a change in the union bargaining power affects the bargained equilibrium, which requires a revision of the Central Bank's strategy.

More precisely, analysis of the strategic game between the social partners and the Central Bank yields interesting findings. Using equations (12), (11), (10) and (5), we can easily compute the following derivatives, recalling that  $B'(\gamma) > 0$ :

$$\frac{\partial l_t^*(\gamma)}{\partial \gamma} = \frac{\partial l_t^*}{\partial B} \frac{\partial B}{\partial \gamma} > 0, \quad \frac{\partial \Pi_t^*(\gamma)}{\partial \gamma} = \frac{\partial \Pi_t^*}{\partial B} \frac{\partial B}{\partial \gamma} < 0 \quad \text{and} \quad \frac{\partial W_t^*(\gamma)}{\partial \gamma} > 0 \quad (13)$$

In other words, a lower union bargaining power leads to a lower level of employment and nominal wage, but also a higher level of inflation in the economy. Indeed, decreasing union bargaining power, in the optimal contract framework, leads to lower wages and weaker employment, at the new equilibrium.

In this context of deterioration in the labor market, at the new equilibrium, the optimal strategy of the Central Bank consists of a stronger stabilization of employment at the expense of inflation stabilization. In other words, the Central Bank takes over powerless unions and thus limits the rise in unemployment in the economy.

In a nutshell, a Central Bank which is more active in stabilizing employment mitigates the damaging effects of union bargaining power erosion.

The extent of these effects particularly depends on the Central Bank degree of conservatism ( $I$ ). More precisely, the higher the degree of monetary authority conservatism, the lower the effect of reduced union bargaining power on deviations in employment and inflation (see relation (13)).

Indeed, when the Central Bank is highly conservative, inflation is already highly stabilized. As a consequence, the additional destabilizing effect on inflation previously underlined related to an decrease in bargaining power is weak. In this context, where inflation is strongly monitored (and yet weak), the positive impacts of a more powerful union are felt strongly. More precisely, as the general level of prices is already low, the weak reaction of inflation leads to small real wage drift. In this case, despite a rise in real wage, the level of employment is greater thanks to a stronger union bargaining power.

To sum up, these results could be used to illustrate the Eurozone's current economic situation. Indeed, in a context of decreasing union bargaining power, increasing level of unemployment with lower nominal wage and a weak inflation rate, the Central Bank tries to set a higher level of inflation to offset the loss of union influence in collective bargaining (with Quantitative Easing for instance).

Moreover, our results could also be used to assess the potential effects of an increase in union bargaining power if the Eurozone becomes more committed to structural reforms of labor market institutions. Thus, giving a higher bargaining power to unions could improve the employment situation in the economy. Moreover, it also allows higher nominal wages to be offered without causing additional inflationary pressure. In this context, the Central Bank could mainly focus on the stabilization of inflation. These consequences are even more significant when the Central Bank is highly conservative.

## 5 Empirical evidence

In this section, we aim at providing empirical evidence on the potential impact of the bargaining power of unions on inflation. More precisely, we attempt thanks to a standard panel data model to document whether a high (low) degree of bargaining power of the union  $\gamma$  is associated with a low (high) level of inflation. While  $\Pi^*$  is uniquely set by the central bank in the model, inflation is determined by a large range of factors (demand and supply shocks, monetary phenomena etc.) in reality. In the literature, several studies have used the inflation rate as a proxy to measure central banks' strategy. An economy characterized by low (high) inflation rates would imply

a high (low) degree of inflation aversion. This approach has been sometimes criticized. For instance, Cukierman (1992) points out that institutions can not always ensure their policy outcome, so that an economy with a very conservative central bank can experience periods of high inflation, independently of central banks' preferences. However, in order to match the theoretical model, we will use inflation as the dependent variable in our econometric model.

In addition, as shown in equation (11), the parameter which captures the degree of conservatism of the monetary authority,  $I$ , plays an important role in the level of inflation at the equilibrium. We therefore include central banks' conservatism as an explanatory variable in regressions. Central banks' conservatism is one key element of the description of the monetary authority's preferences. A large literature, beginning with Rogoff (1985), has analyzed the link between the inflation bias, central banks' independence and inflation aversion. Although interesting, these debates are beyond the scope of this article. We aim at using available data on central banks' conservatism to provide some insights as to the role of preferences of the monetary authority in the evolution of inflation.

## 5.1 Econometric approach

We use a fixed-effects panel data model for 36 OECD countries from 1980 to 2015 (on annual data).<sup>13</sup> Our choice to use a fixed-effects model is motivated by the results from the Breusch & Pagan (1980) Lagrangian multiplier test and from the Hausman (1978) test.  $p$ -values for both tests equal 0 so that we reject a pooled regression approach and prefer a fixed-effects model rather than a random-effects model since the Hausman (1978) test concludes for individual country effects correlated with other regressors.

As said previously, the dependent variable is the annual rate of inflation, that we regress with a proxy of unions bargaining power (alternatively with the union trade density or the collective bargaining coverage). Other regressors are introduced. Two explanatory variables related to central banks' preferences and institutional framework: the central banks' conservatism, the central bank independence are used as explanatory variables.<sup>14</sup> Also, we

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<sup>13</sup>The list of countries is: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New-Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

<sup>14</sup>A precise description of data sources is given below.

introduce two control variables that are likely to drive inflation in the short-run: the Total Factor Productivity and the GDP growth rate. Therefore, the regressions consist in:

$$\Pi_{i,t} = \alpha_0 + \beta_1 UBP_{i,t} + \beta_2 CONS_{i,t} + \beta_3 CBI_{i,t} + \beta_4 TFP_{i,t} + \beta_5 GDP_{i,t} + \epsilon_{i,t} \quad (14)$$

with  $UBP$  an indicator of union bargaining power,  $CONS$  the measure of central banks' conservatism,  $CBI$  the central bank independence index,  $TFP$  the total factor productivity and  $GDP$  the annual growth rate of GDP.

## 5.2 Data description

We use the annual growth rate of the consumer price index (CPI) for the price variable, available on the *OECD database*. Data for GDP growth rates and total factor productivity are also taken from the *OECD database*.

For the degree of central bank independence, different index have been provided in the literature. We chose the extended dataset built by Bodea and Hicks who update the well-known Cukierman-Webb-Neyapti index of central bank independence. For Euro Area economies, index used until 1999 is those of the national central banks and from 2000, the index corresponds to the European central bank.

As highlighted by Leveigue & Lucotte (2014), available computations of index for central bank conservatism are scarce. To our knowledge, only Krause & Mendez (2008) and Leveigue & Lucotte (2014) provide central bank conservatism index for a large set of countries and for a sufficient time span. In Leveigue, Lucotte & Pradines-Jobet (2019), the authors update significantly the Leveigue & Lucotte (2014) dataset, covering our set of 36 economies, this dataset has thus been used accordingly.

Finally, the bargaining power of unions is not a directly observable variable, only proxies can be used. Three proxies are commonly suggested in labor economics literature: (1) the union trade density, *i.e.* the percentage of wage and salaries earners that are trade union members, (2) the collective bargaining coverage, *i.e.* "an indicator of the extent to which the terms of workers' employment are influenced by collective negotiation. It is the coverage rate, *i.e.* the number of employees covered by the collective agreement, divided by the total number of wage and salary-earners" (common definition used by OECD, IMF and ILO statistical departments) and (3) the wage gap between union and non-union workers. This union wage gap would perhaps

be the most relevant indicator with respect to the mechanisms highlighted in the theoretical model. However, this measure do not exist for a large set of countries. Indeed, in numerous countries it is not allowed to pay union members and non-union members differently. To our knowledge, such estimates are only available for Canada, the UK and the US.<sup>15</sup> As a consequence, we use series for trade union density and collective bargaining coverage from the *OECD database*. Even if we could consider the collective bargaining coverage as a better proxy, we also regress CPI inflation with the union trade density.<sup>16</sup>

### 5.3 Results

Table 1 presents empirical results with alternative indicators of unions bargaining power. Regression (1) corresponds to the introduction of *Density* as an explanatory variable and regression (2) corresponds to the introduction of *Bargain*.

	Density	Bargain	CONS	CBI	TFP	GDP	$R^2$
(1)	-0.185		-1.621	-0.011	-0.219	0.068	0.12
597 obs.	<i>(0.00)</i>		<i>(0.68)</i>	<i>(0.426)</i>	<i>(0.00)</i>	<i>(0.33)</i>	
(2)		-0.090	-2.353	-0.044	-0.128	-0.068	0.23
387 obs.		<i>(0.041)</i>	<i>(0.019)</i>	<i>(0.018)</i>	<i>(0.00)</i>	<i>(0.338)</i>	

Table 1: Estimation results

This result suggests that both indicators of unions' bargaining power (trade union density and collective bargaining coverage) affect significantly and negatively inflation.  $p$ -values indicate significance of coefficients associated with *Density* and *Bargain*, respectively at the 1% and the 5% level. In addition, a higher degree of central banks' conservatism is associated with a lower inflation rate, as already underlined in the traditional literature. Conversely, the effects of central banks' independence on inflation are unclear. It appears that inflation is negatively correlated with *CBI* at the 5% level in regression (2) while we do not find significant effects of *CBI* on inflation in regression (1). For the two control variables, regressions shed light the unambiguous impact of the total factor productivity *TFP* on the level of prices. However, taking into account the annual growth rate of GDP does

<sup>15</sup>Moreover, existing measures are often sectorial and many questions arise from the difficulty to measure correctly this wage gap.

<sup>16</sup>See Cahuc, Carcillo & Zylberberg (2014) for a discussion on bargaining power indicators.



not yield significant results.

We provide empirical evidence of downward pressures on prices of a high degree of unions' bargaining power. Intuitively, we should expect a positive relationship since one of the aims of unions is to negotiate higher wages leading to upward pressures on prices. As underlined in the theoretical model, the nature of the strategic game between the central bank and unions plays a crucial role on inflation outcome. In our framework, both unions and the central bank worry about employment. As a consequence, when unions are strong enough to bargain a high level of employment, the central bank can focus on inflation stabilization more actively. In other words, in a context where unions have been characterized by a lower bargaining power over time in most of economies, central banks behave less rigorously with regard to price stability.

## 6 Conclusion

The role of the labor market characteristics on the Central Bank trade-off between inflation and unemployment stabilization appears as a crucial question. In this paper, we explicitly consider the strategic interaction between the monetary authority and the social partners (firms and union). In this economy, social partners bargain employment and nominal wage (optimal contract framework), and the Central Bank plays as leader and determines the inflation rate in order to stabilize inflation and employment.

The aim of this paper is to determine the optimal monetary policy in a context where union bargaining power is lower. We show that a powerless union implies to reduce nominal wage, employment, and causes downward pressures on inflation. To offset all these negative effects, the Central Bank has implemented a more active policy to support employment, by letting inflation run. In other words, at equilibrium, a less powerful union calls for more focus on employment by Central Bank.

Overall, this paper shows that a better understanding of inflation through the action of the Central Bank has to take into account the imperfect competition in the labor market. Future research could introduce other labor market specifications. We can think of efficiency wages or a matching model. More generally, it could be relevant to consider Wage Setting - Price Setting models in such a framework in order to analyze effects on inflation.

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