12. THREE UNEMPLOYMENT RATES RELEVANT TO MONETARY POLICY[1]

Lucian CROITORU[2]

Abstract

We construct a Neo-Keynesian model, with a standard utility specification and nominal rigidities, in which monopolistic firms have employment-related norms and the wage bargaining power is variable. Due to norms, firms hire workers in excess of the number of employees required by technology. Workers in excess are efficiency reserves of the firms. We present the implications for the unemployment-inflation trade-off. We show that, with norms and variable bargaining power, besides the natural rate of unemployment, the unemployment rate at which firms establish/cancel norms, and the one at which the labor bargaining power reach maximum are relevant to decision making We show that, in the presence of norms, the response of the unemployment rate to a change in the monetary policy stance is relatively large, and temporarily concomitant increases in the unemployment rate and inflation can occur.

1. Introduction

The conduct of monetary policy is guided by several fundamental principles, two of which refer to money neutrality. One of the two principles, attributed to Friedman (1968) and Phelps (1968) shows that, in the long run, there is no trade-off between inflation and unemployment, as money is neutral. The second principle states that monetary policy can exploit the negative relation between inflation and unemployment in the short term. The standard Neo-Keynesian model (the NK model, for short), which plays an essential role in the conduct of monetary policy, incorporates these principles, but it does not include adjustments in the unemployment rate (Blanchard, 2008). Blanchard and Gali (2008) extended the NK model by introducing the labor market with frictions and sticky wages. This change allows for characterizing the effects of productivity shocks on inflation and unemployment and how they depend on monetary policy and on the nature of labor market frictions.

This paper extends the NK model by allowing the following characteristics of the labor market: (i) part of the employees has key qualifications for the firm's own niche, and

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[1] The views expressed in this paper are those of the author and do not necessarily reflect the views of the National Bank of Romania or of the Romanian Center for Economic Policies.

[2] The National Bank of Romania, the Romanian Centre for Economic Policies, the International Business and Economics Faculty, Academy of Economic Studies.

the other part performs auxiliary activities; (ii) only workers with key qualifications have wage bargaining power; (iii) the wage bargaining power of employees and firms is variable; and (iv) firms have norms regarding the adequate number of auxiliary workers. Due to these norms, the number of workers performing auxiliary activities exceeds the number of workers required by technology. Workers in excess constitute efficiency reserves of a firm. By adding nominal rigidities, we derive a negative relation between inflation and the unemployment rate. Setting or cancelling norms by firms influence this relation through shocks in employment and labor productivity. Likewise, under certain conditions and only temporarily, a large wage bargaining power of labor could cause the unemployment rate to increase without a fall in inflation. We discuss what monetary policy should do in this case.

The paper is organized as follows:

Section 2 presents the model, leaving nominal rigidities in price and wage setting aside. Firms establish norms when aggregate demand is high enough for the unemployment rate, u_t, to drop below a relevant level, u_{nor}. Norms and efficiency reserves can be removed by a fall in aggregate demand so that $u_t \geq u_{nor}$ or by a supply shock. Given the output level, the presence or the absence of norms is reflected in either lower or higher unemployment. When norms are in place, the unemployment rate is lower by u^{xef}_t as compared to its level when norms are not present. Consequently, the response of the unemployment rate to a certain change in production is larger if norms are in place as compared to the situation in which they are not. The response magnitude changes with the cycle, whenever aggregate demand fluctuations cause the unemployment rate to move below or above the threshold u_{nor}.

Bargaining power depends on the aggregate demand and can be expressed in terms of the unemployment rate. In the presence of norms, employees have maximum bargaining power at a low unemployment rate, u_{min}. If there were no norms, the unemployment rate would be u^1_{min}, which is higher than u_{min} with the efficiency reserves. The firm has maximum bargaining power at an unemployment rate that is sufficiently high, $u_{max} \geq u_{nor}$ [3]. Thus, changes in demand determine bargaining power transfers between workers and firms within the interval $[u_{min}, u_{max}]$ if norms are in place or within the smaller interval $[u^1_{min}, u_{max}]$ otherwise. The natural rate of unemployment (u^*) lies within these intervals.

The labor force demand equation results from the price setting behavior of monopolistic firms. The labor force supply equation results from a Nash-bargaining. Both processes depend only on the real wage. The resulting wage is the bargained

[3] The cyclical movement of the unemployment rate response to changes in production is no longer valid if $u_{max} = u_{nor}$.

notional wage. The supply equation shows that the real notional wage increases when the unemployment rate falls[4]. The equilibrium wage is reached at the natural rate of unemployment and maximizes unitary surpluses of both firms and employees. The natural unemployment rate does not depend on norms. But when norms are in place, the unemployment rate gap consists of a classical demand-related unemployment rate gap, which reflects demand's excess or deficit, and of a norms-related component.

Section 3 shows that, in the presence of norms, if $u_t \leq u^* - u^{xef^*}$ and u^* is sufficiently close to u_{min}, a temporary alternative wage setting mechanism can occur. This happens if workers decide to use their bargaining power in order to increase the real wage beyond the notional wage and the representative firm responds by shedding excess workers to preserve its surplus per labor unit. Information asymmetry and inflation expectations could trigger such a decision by workers. If so decided, the real wage, labor productivity and the unemployment rate rise simultaneously, leaving the demand-related unemployment gap, and thus the real marginal cost gap, unchanged.

Section 4 introduces sticky prices in the model. On this basis we derive the Neo-Keynesian relation between current inflation, expected inflation and the expected real marginal cost gap, which, in this model, depends on the unemployment rate. We show that, when in place, norms alter monetary policy effects on this relation. In particular, a change in monetary policy stance produces a relatively high change in the unemployment rate. We also show that the temporary alternative wage setting mechanism leads to an increase in the unemployment rate without a fall in inflation. According to the two fundamental principles, monetary policy can bring the unemployment rate back to the level registered before shedding excess workers by firms only temporarily and at the cost of higher inflation. Section 5 concludes.

2. The model

2.1. Assumptions

Preferences

The representative household is made up of a continuum of members normalized to 1. The proportion of the representative household members which are employed by firms is L , whereas leisure or unemployment is $u = 1 - L$. The preferences of the representative household are defined over a composite consumption good C_t and leisure. Each member of the household maximizes the expected present value of utility

[4] The results of empirical studies dealing with the relation between wages and the unemployment rate are mixed. Blanchflower and Oswald (1994) have shown that there is a strong correlation between wages and unemployment in the USA. By contrast, Blanchard and Katz (1997) have shown, by analyzing regressions for the states of the USA, that there is a correlation between nominal wages and unemployment, but that the wage dependency on unemployment is low and wages are more dependent on their previous levels.

$$E_t \sum_{i=0}^{\infty} \delta^i \left[\frac{C_{t+i}^{1-\sigma}}{1-\sigma} - \chi \frac{L_{t+i}^{1+\phi}}{1+\phi} \right] \qquad (1)$$

where: σ is the coefficient of relative risk aversion of households and ϕ is the inverse of the wage elasticity of labor supply.

The composite consumption good C_t is defined as

$$C_t = \left[\int_0^1 c_{jt}^{\frac{\beta-1}{\beta}} dj \right]^{\frac{\beta}{\beta-1}},$$

where: β is the price elasticity of demand and satisfies the condition $\beta > 1$.

The representative household decides to purchase that combination of individual goods that minimizes the cost of the chosen quantity of the composite good. The cost minimization problem is

$$\min_{c_{jt}} \int_0^1 p_{ij} c_{ij} dj$$

provided that

$$\left[\int_0^1 c_{jt}^{\frac{\beta-1}{\beta}} dj \right]^{\frac{\beta}{\beta-1}} \geq C_t,$$

where: p_{jt} is the price of the good j. Solving this problem, one can obtain the demand (c_j) for each consumption good j:

$$c_{jt} = C_t \left(p_t / \overline{p}_t \right)^{-\beta} \qquad (2)$$

In equation (2), $\overline{p}$ stands for the economy-wide average price level, whereas p is the average production price of a firm. The ratio $\left(p_t / \overline{p}_t \right)^{-\beta}$ gives the negative slope of the demand for the firm's products.

The aggregated budgetary constraint of the consumer is

$$C_t + B_t / \overline{p}_t = \left(\overline{W}_t / \overline{p}_t \right) L_t + \left(1 - r_{t-1} \right) \left(B_{t-1} / \overline{p}_t \right) \qquad (3)$$

where: $\overline{W}_t$ is the economy-wide average nominal wage, B_t is the nominal value of the bonds owned by consumers and r_t is the interest rate. Relations (1) and (3) give the inter-temporal optimality condition which establishes the marginal rate of substitution between leisure and consumption:

$$\chi L_t^{\phi} / C_t^{-\sigma} = \overline{W}_t / \overline{p}_t \qquad (4)$$

Technology

Each monopolistically competitive firm produces a differentiated final good j . All firms have access to an identical technology, which is assumed to vary exogenously over time. Given this technology, each firm requires a number of employees with key qualifications for its own market niche (L^{np}) and a number of workers who are auxiliary to the production process (L^{sb}). The unemployment rates u^{np} and u^{sb} match these two categories of workers. The total number of employees is given by $L^{P}{}_{t} = L^{np}{}_{t} + L^{sb}{}_{t}$. Accordingly, the unemployment rate is $u^{P}{}_{t} = u^{np}{}_{t} + u^{sb}{}_{t}$. Due to technology, the ratio of the auxiliary workers to the ones with key qualifications (c_p) is constant:

$$L^{sb}{}_{t} = c_p L^{np}{}_{t} \tag{5}$$

Thus, $L^{P}{}_{t}$ can be written as

$$L^{P}{}_{t} = 1 - u^{P}{}_{t} = (1 + c_p)L^{np}{}_{t}\text{, with } c_p > 0 \tag{6}$$

and the production (Y_t), equal to consumption C_t , is directly proportional to the number of employees $L^{np}{}_{t}$

$$Y_t = \eta_{xef}(1 + c_p)L^{np}{}_{t} \tag{7}$$

where: η_{xef} is labor productivity, which we assume to be constant.

Norms

Our hypothesis is that firms' anticipation of long-lasting good economic prospects is matched by a reduction in their rationality regarding employment. When economic perspectives are favorable, during the upturn of the business cycle, firms establish norms (in the sense described by Akerlof, 2007) regarding the 'adequate' number of auxiliary workers[5], making the actual number of auxiliary workers systematically larger than $L^{sb}{}_{t}$. Let $u^{xef}{}_{t}$ be the number of workers in excess of the number of workers required by technology. Thus, given the aggregate demand, firms set a new 'normal'

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[5] Norms are established in relation with workers performing routine activities and not with those with key qualifications for the firm's own niche because the relation between the former and technology is less strict. For example, a software firm can function with 50 programmers, each using a computer. Technology requires two hardware engineers to solve the problems that may arise when using the computers. Yet, the firm and workers can agree that it is safer to hire four hardware engineers. Obviously, the workload is larger when using only two engineers.

level of unemployment, $L^R_{\;t}$, and a corresponding new 'normal' rate of unemployment, $u^R_{\;t}$, which satisfies the relation

$$u^R_{\;t} = u^P_{\;t} - u^{xef}_{\;t} \tag{8}$$

where: $u^{xef} > 0$. Equation (8) shows that the (new 'normal') unemployment rate when norms are in place, $u^R_{\;t}$, is lower than the (old 'normal') unemployment rate, $u^P_{\;t}$, with excess workers $u^{xef}_{\;t}$. Being in excess, the personnel u^{xef} do not influence the output level, but diminish labor productivity, thus representing firms' efficiency reserves. Likewise, $u^{xef}_{\;t}$ can be interpreted as a 'comfort rate' enjoyed by both employees and government[6].

Firms establish norms when aggregate demand is high enough for the number of employees with key qualifications to exceed a relevant level L^{np}_{nor}, so that the unemployment rate drops below the relevant rate u_{nor}. It is of help to note that $u_{nor} = u^{np}_{nor} + u^{sb}_{nor}$, which in view of equation (6) means that $u_t < u_{nor}$ whenever $u^{np}_{\;t} < u^{np}_{nor}$. Relative to the new 'normal' level of unemployment, firms are rational agents and seek to avoid having employees in excess of $L^R_{\;t}$[7].

However, firms come to regard the excess workers u^{xef} as efficiency reserves in two cases. First, when demand falls sufficiently so that $u_t \geq u_{nor}$. As can be deducted from (7), at equilibrium, $(1 + c_p)\Delta L^{np}_{\;t} = -(1 + c_p)\Delta u^{np}_{\;t}$ reflects a change in

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[6] If the firm did not hire excess workers, the latter would receive unemployment benefits smaller than their wages, thus increasing government expenditures. Because $L + u = 1$, the ratio $u^{xef} / (L + u) = u^{xef}$.

[7] In addition to the result induced by norms, a firm can also hire excess workers if it anticipates a significant increase in demand. Hiring personnel is difficult when demand increases at relatively high rates. Firms build up personnel "reserves" from both categories in order to be prepared to respond to increasing demand. But these reserves are temporary. They run out as demand increases and firms use personnel reserves to produce more. Thus, they are not efficiency reserves of firms. It is reasonable to assume that at the natural rate of unemployment or at a smaller rate, firms have used up these personnel reserves. We agree with John Vickers (1995), who found a trade-off between the costs of having slacks and the cost of risk. If the future payment is related to a performance ratio, it would be best for a manager to act inefficiently now in order to maintain the potential for achieving future gains with average efforts. In our view, there is no contradiction between this approach and the neoclassical theory.

aggregate demand. Second, if firms face a supply shock (z) that forces them to dismiss excess workers, or, in other words, to use the efficiency reserves.

A supply shock can change the way a firm perceives the number of employees if it has the power to 'unveil' the efficiency reserves. In our view, a shock has this power if it reduces the surplus per worker left to the firm. Such a shock forces the firm to cancel norms and use the efficiency reserves in order to preserve its surplus or to minimize a reduction of it. Thus, z is equal to 1 if there is a negative supply shock that forces a firm to cancel norms and use its efficiency reserves and is equal to zero otherwise.

We define u^{xef} as a constant fraction (c_{xef}) of the minimum number of auxiliary workers hired after firms established norms. Thus, if $z = 0$ and $u_t < u_{nor}$, $c_{xef} > 0$. Otherwise, $c_{xef} = 0$. In view of equation (5), if firms are hiring, (meaning that $u^{np}{}_t < u^{np}_{nor} < u^{np}_{t-1}$), $u^{xef}{}_t$ can be written as

$$u^{xef}{}_t = -c_p c_{xef}(1 - z_t)\Delta u^{np}_{nor\,t} = -hc_p c_{xef}(1 - z_t)\Delta u^{np}{}_t \qquad (9')$$

where: $\Delta u^{np}{}_t = u^{np}{}_t - u^{np}{}_{t-1}$, $h \in (0,1] = \Delta u^{np}_{nor\,t} \big/ \Delta u^{np}{}_t$, and $\Delta u^{np}_{nor\,t} = u^{np}{}_t - u^{np}_{nor}$.

Equation (9`) gives the number of workers hired in excess of the number of workers required by technology.

Alternatively, according to (9`), when firms shed labor (meaning that $u^{np}{}_{t-1} < u^{np}_{nor} < u^{np}_t$), the total number of excess workers that can be dismissed at time t is

$$u^{xef}{}_{t-1} = -c_p c_{xef}(1 - z_t)\Delta u^{np}_{nor\,t} = hc_p c_{xef}(1 - z_t)\Delta u^{np}{}_t \qquad (9''),$$

where: $\Delta u^{np}_{nor\,t} = u^{np}{}_{t-1} - u^{np}_{nor}$. From (9') it results that a decrease or, respectively, an increase in this number is given by $\Delta u^{xef}{}_t = \pm c_p c_{xef}(1 - z_t)\Delta u^{np}{}_t$, when both $u^{np}{}_t$ and $u^{np}{}_{t-1}$ are lower than u^{np}_{nor}.

Equations (8) and (9`) and (9``) show that the unemployment rate depends on $L^{np}{}_t$ (which in turn depends on demand), as also shown by equation (6), but also on z and c_{xef}, reflecting the presence or absence of norms and efficiency reserves. If $z = 1$ or $u_t \geq u_{nor}$ (that is, in the absence of norms), given the production level, the number of workers is set by technology. If $z = 0$ and $u_t < u_{nor}$ (that is, in the presence of norms), the number of workers with key qualifications is set by technology, but the actual number of auxiliary workers is set by both technology and norms.

Using the previous notations, the general form of the production function of the representative firm is

$$Y_t = \begin{cases} \eta L_t = \eta(1-u_t) = \eta\left[(1+c_p)L^{np}_t + u^{xef}_t\right] \text{ if } z=0,\ u_t < u_{nor} \text{ and } \Delta u^{np}_t \neq 0 & (10) \\ \eta_{xef} L_t = \eta_{xef}(1-u_t) = \eta_{xef}(1+c_p)L^{np}_t \text{ if } z=1 \text{ or } u_t \geq u_{nor} \text{ and } \Delta u^{np}_t \neq 0 & (11) \\ Y_{t-1} \quad \text{if } u_t = u_{t-1} + u^{xef}_{t-1} \text{ and } \Delta u^{np}_t = 0 & (12), \end{cases}$$

where: the constant η is the labor productivity in the presence of norms.

Equation (10) specifies the production function when firms have efficiency reserves and equation (11) specifies the production function when firms have no efficiency reserves[8]. Both equations show that the firm's output depends on the number of employees. Equation (12) shows that using the efficiency reserves leaves production unchanged.

The alternation between equations (10) and (11) is determined by the cyclical movement of demand and by supply shocks which 'unveils' firm's efficiency reserves. Once adopted, norms operate as long as $u_t < u_{nor}$ and are not canceled by firms in response to a shock ($z=0$). If $z=0$ and demand increases or decreases within limits that leave the inequality $u_t < u_{nor}$ valid, the production function is given by equation (10). We assume that this lasts for i consecutive periods ($i \geq 1$ is an integer), after which demand decreases sufficiently for $u_t \geq u_{nor}$ and norms are cancelled. If for l periods ($l \geq 1$ is an integer) demand increases or decreases so that $u_t \geq u_{nor}$, the production function is given by equation (11). Firms reestablish norms after l periods, when demand increases again high enough so that $u_t < u_{nor}$ and the cycle repeats itself.

A supply shock that leads firms to cancel norms and use the efficiency reserves at time t, when $u_t < u_{nor}$, remains in the memory of firms for i consecutive periods (here $i \geq 1$ shows the number of consecutive periods in which $u_t < u_{nor}$ after the shock). Thus, if $z=1$ and demand increases or falls within limits that leave the inequality $u_t < u_{nor}$ valid for i consecutive periods, the production function is given by equation (11). If after i consecutive periods, employment falls for l consecutive periods, so that $u_t \geq u_{nor}$, production is also given by equation (11). Firms reestablish norms once demand increases enough for $u_t < u_{nor}$, so that the production function is again given by equation (10).

[8] This definition is consistent with the idea that labor productivity is constant as long as the firm does not change its technology, but it can grow by using efficiency reserves.

The cyclical evolution of aggregate demand that leads firms to establish or cancel norms, and/or a supply shock that reduces the surplus per worker left to the firm, produces shocks in unemployment rate and labor productivity.

With respect to the business cycle, u^{xef} is a measure of the shock to the unemployment rate at the time when the unemployment rate drops below u_{nor} and firms establish norms, or, alternatively, at the time when the unemployment rate equals or goes beyond u_{nor}, and firm cancel norms. A change in demand (captured by $\pm\left(1+c_p\right)\Delta u^{np}{}_t$) that causes unemployment rate to move from $u_{t-1} > u_{nor}$ to $u_t < u_{nor}$ or the other way around, from $u_{t-1} < u_{nor}$ to $u_t > u_{nor}$, is reflected by the relation[9]

$$u_t - u_{t-1} = \left(1 + c_p + hc_p c_{xef}\right)\Delta u^{np}{}_t \text{ with } h \in (0,1) \text{ and } \forall\ u_t \in (0,1) \qquad (13)$$

From (13) it results that a change in the unemployment rate in response to a change in aggregate demand for the unemployment rate interval $\left(0, u_{nor}\right)$ if norms are present is

$$u_t - u_{t-1} = \left(1 + c_p + c_p c_{xef}\right)\Delta u^{np}{}_t \text{ if } z = 0 \text{ and } u_t < u_{nor} \qquad (14)$$

and after the cancellation (or before the adoption) of norms is

$$u_t - u_{t-1} = \left(1 + c_p\right)\Delta u^{np}{}_t \text{ if } z = 1 \text{ or } u_t \geq u_{nor} \qquad (15)$$

Equations (14) and (15) show that changes in demand entail relatively large changes in the unemployment rate if employment is higher than L^{np}_{nor} and norms are in place, as compared to the situation in which employment is equal to or falls below this level and norms are cancelled. Absent norms, a change in the unemployment rate reflects only a change in demand. When norms are present, a change in the unemployment rate reflects both a change in demand and a change in the number of excess workers.

In the case of a supply shock that leads firms to dismiss excess workers (instantaneous use of efficiency reserves), by leaving the production level unchanged, the shock $u^{xef}{}_{t-1}$ to the unemployment rate is given by the equation (9`) and satisfies the equation:

$$u_t - u_{t-1} = u^{xef}{}_{t-1} \qquad (16)$$

where: u_t is the unemployment rate after the shock (when there are no efficiency reserves left, and therefore $u_t = u^P{}_t$) and u_{t-1} is the unemployment rate at the time of

[9] This is obtained by subtracting ecuation (10) at time t from ecuation (10) at time $t+1$ and taking into account that $\Delta L_t = -\Delta u_t$ and $\Delta L^{np}{}_t = -\Delta u^{np}{}_t$.

the shock (when efficiency reserves still existed, and therefore $u_{t-1} = u^{R}_{t}$). Equation (16) shows the increase in unemployment rate due exclusively to the use of efficiency reserves.

At the time t when norms are removed (including due to shocks), labor productivity jumps to the constant level η_{xef} to satisfy the relation:

$$I_{\eta} = \eta_t / \eta_{t-1} = \eta_{xef} / \eta = (1 - u_{t-1})/(1 - u_t), \text{ where } u_t = u_{t-1} + u^{xef}_{t-1} \tag{17}$$

Given the efficiency reserves and the wage level, the firms set prices to maximize profit. Once the prices are set by each firm, the demand for the products of a firm is given by equation (2). Knowing that, at equilibrium, demand is equal to production, the level of production is implicitly determined.

2.2. Wage setting

The wage is set through a Nash-bargaining between each firm and its workers, in the absence of any rigidity concerning the nominal wage. This is the notional wage. The notional wage is the generalized Nash solution when firms and workers bargain over wages, but not employment.

The real notional wage is set at a level that concomitantly maximizes both the firm's surplus (S_f^{1-a}) and the workers' surplus (S_e^a). Thus, the real notional wage in a Nash-bargaining is obtained from the condition

$$\text{Max } S_f^{1-a} S_e^a \tag{18}$$

where: a stands for the bargaining power of labor, which can range between 0 and 1.

Accordingly, the firms' bargaining power is $1 - a$. In condition (18), the surpluses left to firms and employees, as well as the bargaining power, need to be defined. We begin by defining the bargaining power as a function of the unemployment rate.

2.2.1. Bargaining power and the unemployment rate

In most macroeconomic models, all employees are assumed to have a constant bargaining power. In this model we assume that only workers with key qualifications for the firm own niche have bargaining power, while auxiliary workers do not[10].

If only workers with key qualifications have bargaining power, we can admit that the variation in the bargaining power of labor depends on $\Delta L^{np}_{t} = -\Delta u^{np}_{t}$, similarly to variations in production level. Since Δu^{np}_{t} depends on changes in the aggregate

[10] The assumption is backed by the "competitive approach" to wage setting in the labor market. According to this approach, some of the unemployment is simply a consequence of diminished opportunities in the labor market for some workers relative to their reservation wage. "Especially at the bottom end of the skill distribution, workers have little or no bargaining power because they can be replaced easily" (Blanchard, 1997, p. 54).

demand, then the variations in the bargaining power of labor depend on fluctuations in aggregate demand too, similarly to variations in production.

Given labor productivity, the higher the aggregate demand the stronger the labor force demand and the bargaining power of labor. The latter reaches its maximum ($a=1$) if u^{np}_{t} is equal to or below a critical value $u^{np}_{a=1}$ ($u^{np}_{t} \le u^{np}_{a=1}$, with $u^{np}_{a=1} > 0$). Conversely, the workers' bargaining power reaches its minimum ($a=0$) if aggregate demand is low enough for the unemployment rate of the workers with key qualifications to be equal to or higher than the critical value $u^{np}_{a=0} \ge u^{np}_{nor}$ ($0 < u^{np}_{t} \le u^{np}_{nor} \le u^{np}_{a=0}$ and $0 < u^{np}_{a=1} < u^{np}_{a=0}$). Wage bargaining occurs within the interval $\left[u^{np}_{a=1}, u^{np}_{a=0}\right]$.

Within this interval, the distance at time t of the workers' bargaining power from its maximum ($1-a_t$) is a function of the distance of u^{np}_{t} from $u^{np}_{a=1}$, so that

$$1-a_t = \varphi\left(u^{np}_{t} - u^{np}_{a=1t}\right) = \varphi \Delta u^{np}_{a=1t} \tag{19}$$

where: $\Delta u^{np}_{a=1t} = u^{np}_{t} - u^{np}_{a=1}$, and φ is a positive coefficient showing the intensity of the relation between a and $\Delta u^{np}_{a=1t}$. The restriction $a \in [0,1]$ yields that $\Delta u^{np}_{a=1t} \in [0, 1/\varphi]$, that is the length of the bargaining interval is $u^{np}_{a=0} - u^{np}_{a=1} = 1/\varphi$.

This interval matches a range expressed in terms of the current unemployment rate. According to (13), if $z=0$ the interval is $[u_{min}, u_{max}]$, its length is $[u_{max} - u_{min}] = (1 + c_p + hc_p c_{xef})1/\varphi$ and $h = (u^{np}_{nor} - u^{np}_{a=1})/(1/\varphi)$. According to (15), if $z=1$, this interval is $[u^{1}_{min}, u_{max}]$, its length is $[u_{max} - u^{1}_{min}] = (1 + c_p)1/\varphi$. u_{min} and u^{1}_{min} are the unemployment rates for which $a=1$ and u_{max} is the unemployment rate for which $a=0$[11]. Equation (8) guarantees that $u_{min} = u^{1}_{min} - u^{xef}$, where $u^{xef} = c_p c_{xef}\left(u^{np}_{nor} - u^{np}_{a=1}\right)$ is the maximum amount of efficiency reserves accumulated in the bargaining interval. Thus, the bargaining power equation is as follows

$$a_t = \begin{cases} 1 & \text{if } u_t \le u_{min} \text{ and } \Delta u^{np}_{t} \le 0 & (20) \\ 1-\lambda(u_t - u_{min}) & \text{if } u_t \in (u_{min}, u_{max}) \text{ and } \Delta u^{np}_{t} \ne 0 & (21) \\ 0 & \text{if } u_t \ge u_{min} + 1/\lambda \text{ and } \Delta u^{np}_{t} \ge 0 & (22) \\ a_{t-1} & \text{if } u_t = u_{t-1} + u^{xef}_{t-1} \text{ and } \Delta u^{np}_{t} = 0 & (23) \end{cases}$$

[11] By definition, when the workers' bargaining power is zero, the coefficient $c_{xef} = 0$, which explains why the upper limit is the same for the two intervals.

where: λ is a constant that simultaneously satisfies the restrictions $\lambda = \varphi / \left(1 + c_p + hc_p c_{xef}\right)$ and $\lambda \geq 1/\left(1 - u_{min}\right)$. The restriction $a \in [0,1]$ yields that $u_t - u_{min} \in [0, 1/\varphi]$, that is the length of the bargaining interval is $u_{max} - u_{min} = 1/\lambda$. If we do not allow for norms, the equation (23) does not hold any longer and the equations (20)-(22) have to be rewritten to replace λ by λ_1 and u_{min} by u^1_{min}, where $\lambda_1 = \varphi / \left(1 + c_p\right)$[12].

Equation (21) shows that, within the interval $[u_{min}, u_{max}]$, the closer the current unemployment rate is to u_{min}, the stronger the bargaining power of labor and vice versa. Equation (23) shows that during a shock that triggers the use of efficiency reserves, the bargaining power stays put.

The upper limit of the interval in which the bargaining power is transferred between employees and the firm depends on λ (equation (21)). The higher λ, the smaller the interval $[u_{min}, u_{max}]$ in which the bargaining power influences the wage setting[13]. The employees and the firm have equal bargaining power when $u_t = \left(u_{min} + u_{max}\right)/2$.

The bargaining power equation is consistent with the idea that on a depressed labor market, the workers' bargaining power is small, as finding a job can prove difficult. This is reflected in the setting of a relatively low negotiated wage. Conversely, in a tight labor market, the workers' bargaining power is high and the negotiated wage exceeds significantly the reservation wage.

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[12] The distance from u_t to u_{min} or to u^1_{min} is obtained by replacing Δu^{np}_t in equations (13) and (15) with $\Delta u^{np}_{a=1_t}$ and solving for the latter. The value obtained for $\Delta u^{np}_{a=1_t}$ is replaced in equation (19) and the workers' bargaining power is obtained in terms of the deviation $u_t - u^1_{min}$. The bargaining power for the definition interval is $a_t = 1 - \lambda_1\left(u_t - u^1_{min}\right) = 1 - \lambda_1\left(u_t - u_{min} - u^{xef}\right)$, where $\lambda_1 = \varphi/\left(1 + c_p\right)$. In order to write this expression exclusively in terms of $u_t - u_{min}$, we must make sure that $a_t = 1 - \lambda_1\left(u_{max} - u^1_{min}\right) = 1 - \lambda(u_{max} - u_{min})$. This equality is valid if $\lambda = \varphi/\left(1 + c_p + hc_p c_{xef}\right)$.

[13] In turn, the lower λ, the higher c_p and c_{xef}. Thus, the larger the efficiency reserves, the wider the interval of the unemployment rates for which a and $u_t - u_{\min}$ are determined.

2.2.2. The workers' and firms' surplus

Assuming that $z = 0$, $u_t \in [u_{min}, u_{nor})$ and that the capital is firm-specific, having no alternative use, the surplus per worker left to the firm is [14]

$$S_{f_t} = p_t D_t / L_t - \overline{p}_t \left(f(1 - u_{min}) \eta / L_t \right) - W_{st} \tag{24}$$

where: W_{st} is the nominal wage received by the worker, D_t is the demand for the representative firm's output, f is a constant that represents the ratio of the fixed costs of production[15] to the value of output when the unemployment rate is u_{min}.

The worker's surplus is given by the difference between wage W_{st} paid by the firm and the expected wage. The latter is equal to the arithmetical mean of the economy-wide average nominal wage, $\overline{W}_t$, weighted by the likelihood $1 - u_t$ he or she will be employed and the reservation wage, S_t, which approximates the value of leisure, weighted by the likelihood u_t he or she will be unemployed. Considering that s is the constant ratio of the reservation wage to the nominal value of production per unit of labor ($s = S_t / (\overline{p}_t Y / L)$, then the reservation wage can be written as $S_t = s \eta \overline{p}_t$, where $s\eta$ is the reservation wage in real terms. Thus, the worker's surplus is given by:

$$S_{et} = W_{st} - \left(\overline{W}_t (1 - u_t) + u_t s \eta \overline{p}_t \right) \tag{25}$$

According to the intra-temporal optimality condition setting the marginal rate of substitution between leisure and consumption, the expected wage should fulfill the condition $\chi L_t^{\phi} / C_t^{-\sigma} = \left(\overline{W}_t / \overline{p}_t \right)(1 - u_t) + u_t s \eta$. This means that the worker's surplus will be positive only if $\left(\overline{W}_t / \overline{p}_t \right) > s\eta$.

With values of S_f and S_e given by equations (24) and (25), condition (18) becomes

$$\text{Max} \left(p_t D_t / L_t - \overline{p}_t \left(f(1 - u_{min}) \eta / L_t \right) - W_{st} \right)^{1-a_t} \times \left[W_{st} - \left(\overline{W}_t (1 - u_t) + u_t s \eta \overline{p}_t \right) \right]^{a_t} \tag{26}$$

with the bargained real notional wage ($w_{st} = W_{st} / p_t$) for which this condition is fulfilled given by:

$$w_{st} = a_t \left[\left(p_t D_t - \overline{p}_t f (1 - u_{\min}) \eta \right) / \overline{p}_t L_t \right] + (1 - a_t) \left[\overline{W}_t / \overline{p}_t (1 - u_t) + u_t s \eta \right] \tag{27}$$

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[14] A similar definition is presented by Akerlof, Dickens and Perry (1996), in which S_{f_t} is defined in terms of u^*. To keep the equations simple, we decided to define S_{f_t} in relation to u_{min}.

[15] We could exclude f from the definition of the firm's surplus, but we considered necessary to keep it, as in the case of prices of certain products like software, medicines, etc., the fixed costs hold a larger share than the marginal ones, so that the price reflects more the mark-up rather than the marginal costs.

In equation (27) $\overline{W}/\overline{p}$ represents the economy-wide average real wage. The real notional wage (w_{s_t}) is a weighted arithmetical mean of the firm's real variable cost per worker and the real opportunity cost of the worker. According to equation (21), the weights of these costs in real wage formation depend on the difference $u_t - u_{min}$ for as long as the difference ranges within the interval $(0, 1/\lambda)$. In accordance with equations (21), (24), (25) and (27), when the difference $u_t - u_{min}$ is zero, the firm's surplus equals zero as well. Conversely, if $u_t - u_{min} = 1/\lambda$, the worker's surplus is zero. Obviously, if $z = 1$ or $u_t \geq u_{nor}$, there are no longer any norms or efficiency reserves, so that equations (24), (25), (26) and (27) should be rewritten to substitute η, u_{min}, and λ by η_{xef}, u^1_{min} and λ_1 respectively. This outlines that when norms are in place, the negative relation between the real wage and the unemployment rate takes place at lower levels of real wages, as compared to the case when norms are missing.

2.3. Equilibrium with flexible prices

For the representative firm, the labor market equilibrium is reached at the intersection of supply and demand equations. The demand equation results from the price setting process conducted by firms, while the supply equation results from the wage-setting mechanism. Both processes depend on the real wage. Further in this section we write the labor demand and supply equations and introduce the natural rate of unemployment.

2.3.1. Demand and supply equations on the labor market

Assuming further that $z = 0$ and $u_t \in [u_{min}, u_{nor})$, a firm that produces final goods will set the price p in order to maximize the difference

$$\text{Max } p_t C_t (p_t / \overline{p}_t)^{-\beta} - W_t (1/\eta) C_t (p_t / \overline{p}_t)^{-\beta} \tag{28}$$

where: $W_t(1/\eta)$ is the nominal marginal cost of the firm. Under flexible prices, all firms will set the same price, so that the difference in equation (28) reaches its maximum for a constant value of the real wage $W_t / p_t = w_{d_t}$ [16] equal to

[16] Equation (29) can be derived by making the distinction between the firms producing final goods, facing monopolistic competition, and the firms producing intermediary goods, facing perfect competition. Profit maximization by firms producing intermediary goods is conditional on the equality between real marginal revenue product of labor and real marginal cost: $\eta P^I / P = w$, where P^I is the price of the intermediary good and P is the price index associated with C. Profit maximization by firms producing final goods requires that $P = \mu P^I$. By replacing the value of μ in the previous equation, we obtain equation (29).

$$w_{d_t} = \eta(\beta - 1)/\beta = \eta/\mu \qquad (29)$$

where: $\beta/(\beta-1) = \mu$ represents the optimal gross markup that the firm adds to the nominal marginal cost.

Equation (29) represents the labor demand equation. It describes the wage that is consistent with the willingness of firms to hire, given the general conditions regarding input prices, the tax system, interest rates etc., and the condition that firms make zero economic profit. Equation (29) is consistent with the idea that real wages are neutral to the business cycle. The constant value of the real wage results from both the constant price elasticity of demand in equation (2) and the assumption that labor productivity is constant. The higher the labor productivity or the price elasticity of demand, the higher the wage w_{d_t}. From the definition of nominal marginal cost it results that $w_{d_t}/\eta = 1/\mu$ is the real marginal cost of the firm.

As real wage equation that results from the price setting mechanism gives labor demand, the real wage equation resulting from the wage setting process provides the labor supply equation. Noting that, at equilibrium, $D = Y$, $p = \overline{p}$, $\overline{W}/\overline{p} = \eta(\beta-1)/\beta$ and taking into account equations (20)-(22), then equation (27) of the notional real wage per worker will read as follows:

$$w_{st} = [1 - \lambda(u_t - u_{min})]\eta[1 - f(1 - u_{min})/(1 - u_t)] + \lambda(u_t - u_{min})\eta[(1 - u_t)(\beta - 1)/\beta + u_t s] \qquad (30)$$

Equation (30) shows the negative non-linear dependence of the real wage on the unemployment rate for $u_t \in (u_{min}, u_{max} = u_{min} + 1/\lambda)$ and if $\Delta u^{np}{}_t \neq 0$. The real wage curve on supply side, w_{st}, reflects market forces and the will of workers and firms. Outside the interval $[u_{min}, u_{max}]$, the firms' and workers' surplus cannot be simultaneously positive and the work relations are privately inefficient. To make sure that the two surpluses are positive, the real wage must satisfy the condition: $\eta_{xef}\left[(1 - u_{min} - 1/\lambda)(\beta - 1)/\beta + (u_{min} + 1/\lambda)s\right] \leq w_{st} \leq \eta(1 - f)$. If $z = 1$, this condition can be rewritten with η being replaced by η_{xef}. Likewise, if $z = 1$ or $u_t \geq u_{nor}$, equations (29) and (30) have to be rewritten by replacing η, u_{min}, and λ by η_{xef}, u^1_{min} and λ_1 respectively.

Under perfectly flexible prices and wages, the equilibrium between w_{d_t} and w_{s_t} is reached at the natural rate of unemployment. Our model shows that the equilibrium wage is influenced by the business cycle, which determines firms to establish/cancel norms or by a shock that reduces the surplus left with the firm from each worker. When firms establish norms ($u_t < u_{nor} < u_{t-1}$), labor productivity drops from η_{xef} to η and the wages given by equations (29) and (30) are equal at a relatively low level. When firms cancel norms ($u_{t-1} < u_{nor} < u_t$) or a supply-side shock takes place, labor productivity returns to the η_{xef}, while wages grow to the levels indicated by equations (29) and (30) adjusted for productivity[17] and for u^1_{min} and λ_1.

According to equation (13), (17) and (30), a change in demand that causes the unemployment rate to move from $u_{t-1} > u_{nor}$ to $u_t < u_{nor}$ or vice versa, from $u_{t-1} < u_{nor}$ to $u_t > u_{nor}$, determines a disruption of the negative relation between wages and unemployment. The disruption occurs because of the labor productivity jump to a new constant level that occurs (equation (17)) when the unemployment rate (equation (13)) drops below or increases beyond (or equals) u_{nor}, which is the trigger for norms establishing/cancelling. When this happens, the unemployment rate and the wage (equation (30)) decrease or, respectively, increase together (($w_t(u_{t-1}) > w_t(u_t)$ or $w_t(u_{t-1}) < w_t(u_t)$).

Equations (16), (17) and (30) indicate that a disruption of the negative wage-unemployment rate relation also occurs when firms respond to a supply-side shock by dismissing excess workers. This response leads to an increase in the unemployment rate (equation (16)) and determines a jump of labor productivity to a higher constant level (equation (17)) and thus an increase in the real wage (equation (30) or (30) adjusted). After each of the two possible disruptions, the negative wage-unemployment rate relation resumes.

2.3.2. The natural rate of unemployment and the norms

In this section we first show that the natural rate of unemployment depends on the reservation wage, the ratio of fixed costs of production to the value of production, the length of the negotiation interval and the price elasticity of demand, but not on norms. Then we show the relation between these parameters that secures positive surpluses for the representative firm and each of its workers. Finally, we show that while norms do not influence the level of the natural rate of unemployment, they alter the meaning of the unemployment rate gap by reducing its capacity to reflect aggregate demand excess or deficit.

To identify the natural rate of unemployment's determinants we use equation (29) for the real wage consistent with profit maximization and equation (30) for the real wage resulting from the wage setting process, written by replacing u_{min} and λ by u^1_{min} and λ_1 respectively, to obtain the expression for the real marginal cost (MC):

$$MC = \left[1-\lambda_1\left(u_t - u^1_{min}\right)\right]\left[1 - f\left(1-u^1_{min}\right)/\left(1-u_t\right)\right] + \lambda_1\left(u_t - u^1_{min}\right)\left[\left(1-u_t\right)\left(\beta-1\right)/\beta + u_t s\right] \quad (31).$$

Since the real marginal cost does not change when labor productivity moves from η_{xef} to η and vice versa, the equation (31) written as above equals the equation (31)

[17] The decrease/increase in wages that accompanies norms' adoption/cancelation by firms is explained by the increase/decrease in the weight of auxiliary workers that are paid lower wages than the workers with key qualifications.

written by replacing u_{min}^{1} and λ_1 by u_{min} and λ by respectively. This means that the natural rate of unemployment is not influenced by norms' establishment/cancelation.

The natural rate of unemployment is that value of the unemployment rate, u^*, for which equation (31) equals equation (29) divided by η. It depends on parameters f, s, λ_1, and β. Given the parameters f, s, λ, the natural rate of unemployment depends on the optimal gross markup each firm adds to its marginal cost, μ, which depends in turn on β ($\mu = \beta/(\beta-1)$). *Ceteris paribus*, the lower the markup, the lower the natural rate of unemployment and closer to u_{min}. As Blanchard says, "How markups move, in response to what, and why, is however nearly terra incognita for macro" (2008, p. 18).

To identify correlations between parameters f, s, λ_1, and β we start from the fact that, in accordance with equation (21), the difference $u_t - u_{min}$ has an impact on wage bargaining if the former ranges within the interval $[0,1/\lambda]$. This condition is met if the price elasticity of demand ranges within the interval $[1/(1-s),1/f]$[18]. If $\beta = 1/f$, then $u_t = u_{min}$. This situation is little likely to occur because the firm's surplus from each worker would be zero. If $\beta = 1/(1-s)$, then $u_t = u_{max}$[19]. This case is also little likely to materialize, as the surplus of each worker would be zero. If $\beta \in (1/(1-s),1/f)$, then u_t ranges between u_{min} and u_{max}. In this case, the firm's and workers' surpluses are positive.

Since it makes sense for firm's and workers' surpluses to be at least zero at the natural rate of unemployment, then $u^* \in [u_{min}, u_{max}]$. This means that the bargaining power of workers reaches its maximum at an unemployment rate equal to or lower than the natural rate of unemployment. The lower the difference $u^* - u_{min}$, the higher the workers' bargaining power at the natural rate of unemployment. The rationales set

[18] $u_t - u_{min} = 0$ if the difference between the wage on the supply side according to equation (30) calculated for $u_t = u_{min}$ and the wage on the demand side according to equation (29) equals zero. Thus, $\eta[1-f-(\beta-1)/\beta]=0$ if $\beta = 1/f$. Also, $u_t - u_{min} = 1/\lambda$ if the difference between equation (30), calculated for $u_t = u_{max}$, and equation (29) equals zero. Thus, $\eta[(1-u_{min}-1/\lambda)(\beta-1)/\beta+(u_{min}+1/\lambda)s]-\eta(\beta-1)/\beta=0$ if $\beta = 1/(1-s)$. In this case, the workers' bargaining power at the natural rate of unemployment is zero. The two combined restrictions support the assertion in the text. It can be shown that $1/(1-s) > 1/f$ if $s < 1-f$.

[19] This means that at u_{max} the real wage on the supply side in equation (30) equals the real wage on the demand side in equation (29) only if the latter is equal to the reservation wage.

forth in this section are also valid if norms are no longer in place. In this case, the natural rate of unemployment ranges within the interval $\left[u^1_{min}, u_{max}\right]$.

To discuss the issue of unemployment rate gaps, let us note again with u^R_t any unemployment rate lower than u_{nor} when norms are in place ($z = 0$), like in equation (8). It is reasonable to assume that the natural rate of unemployment is lower than u_{nor}. According to (8), the unemployment rate gap can be written as $\hat{u}^R = u^R_t - u^* = u^P_t - u^* - u^{xef}_t$. In this relation, $\hat{u}^P_t = u^P_t - u^*$ is the demand-related unemployment rate gap that reflects excess/deficit demand. Thus, given (9'), if $\hat{u}^R_t$ and $\hat{u}^P_t$ are negative, we can write:

$$\hat{u}^R_t = \hat{u}^P_t - u^{xef}_t \qquad (32`).$$

If $\hat{u}^R_t$ and $\hat{u}^P_t$ are positive, given (9'') we can write:

$$\hat{u}^R_t = \hat{u}^P_t + u^{xef}_{t-1} \qquad (32``).$$

Equations (32`) and (32``) show that unemployment rate gaps when norms are in place consist of a demand-related unemployment rate gap reflecting excess demand or a deficit demand, respectively, and a norms-related component, reflecting efficiency reserves. A shock that leads to excess workers layoffs leaves the demand-related unemployment rate gap unchanged, but makes the unemployment rate gap $\hat{u}^R_t$ equal to $\hat{u}^P_t$. Thus, norms make it possible for the unemployment rate to increase without any change in the demand-related unemployment rate gap.

In particular, if the demand-related unemployment rate gap is equal to zero, then $\hat{u}^{R^*} = u^{xef^*} = -c_p c_{xef}\left(u^{np^*} - u^{np}_{nor}\right)$. The last expression is a particular writing of equation (8) when the economy is at full employment, that is when u^P_t is equal to u^*:

$$u^{R^*} = u^* - u^{xef^*} \qquad (33).$$

Equation (33) says that when norms are in place, the natural rate of unemployment has an image in terms of the current rate of unemployment, which is equal to the natural rate of unemployment when norms are not in place minus u^{xef^*}. This means that when the demand-related unemployment rate gap is equal to zero, a shock that results in dismissing all excess workers causes the actual unemployment rate to increase to its natural level.

3. The bargaining power and the temporary alternative wage setting mechanism

The presence of a surplus associated with existing employment relationships means that any path of the real wage that allows for $S_{et} \geq 0$ and $S_{f_t} \geq 0$ for all t is consistent with equilibrium (Hall, 2005 and Blanchard and Gali, 2008). Nash-bargaining generates one of such paths.

In this section we show that if the bargaining power of workers is significantly higher than that of the firm, Nash-bargaining can be temporarily replaced by an alternative wage setting mechanism (AWSM). This temporary mechanism leads to a simultaneous growth of the real wage and the unemployment rate. We first show under what conditions workers can use their bargaining power to increase the real wage above the notional wage. Then, we present the wage growth rate a firm can accommodate without reducing its surplus.

3.1. The bargaining power and the unemployment gap

One reason why workers would want to use their bargaining power to increase the real wage above the notional real wage could be information asymmetry (Acemoglu, 1995). If they have imperfect information regarding the total surplus associated with the employment relationship, workers could demand excessive increases of their wages. Another reason could be the anticipation by workers that the increase in inflation that follows monetary or fiscal policy easing can alter the surplus allocation by reducing the workers' surplus.

There are two conditions to be simultaneously met if workers are to use their bargaining power to demand a real wage higher than the notional real wage. First, the actual unemployment rate must be equal to or lower than the natural rate of unemployment ($u_t \leq u^* - u^{xef^*}$). If this condition is not fulfilled, there is available labor force willing to work for a wage equal to the notional wage. If $u_t \leq u^* - u^{xef^*}$, then there is no more available labor force willing to work for the notional wage. Thus, workers gain the power to demand wage increases above the notional wage level, and may want to give up Nash-bargaining.

Second, the workers' bargaining power must be higher than that of the firm (which means that $u_t < (u_{min} + u_{max})/2$) and the actual rate of unemployment must be sufficiently close to u_{min}. Let $u_x \in (u_{min}, (u_{min} + u_{max})/2)$ be the maximum value of the unemployment rate at which workers can impose wages higher than the notional wage. This means that the AWSM can be triggered when $u_t \in (u_{min}, u_x]$.

Together, the two conditions imply that u^* must be close enough to u_{min}. The two unemployment rates are sufficiently close if given the parameters u_{min}, f, s and λ

(the latter depending on φ, c_p and c_{xef}), the markup μ is small enough, reflecting firms' low market power. If $u^* < \left(u_{min} + u^{xef} + u_{max}\right)/2$, $u^* - u^{xef^*}$ could be higher than, lower than or equal to u_x. By combining the two conditions, it results that the workers' bargaining power can be used for wage increases above the wage notional level if $u_t \leq u_x \leq u^* - u^{xef^*}$ or if $u_t \leq u^* - u^{xef^*} \leq u_x$.

The case where $u_t = u^* - u^{xef^*} \leq u_x$ shows clearly that the real wage could rise above the notional wage due to the workers' high bargaining power, although there is no excess aggregate demand. Obviously, in the case of an inflationary unemployment rate gap ($u_t < u^* - u^{xef^*} \leq u_x$ or $u_t \leq u_x < u^* - u^{xef^*}$), the probability of high bargaining power being used for increasing the real wage above the notional wage is even higher.

The cases described above are essential from the perspective of this paper. They allow us to show the microeconomic rationale of shifting to an AWSM, which leads to the simultaneous increase in the real wage and the unemployment rate. Further on, we show this rationale.

3.2. The positive correlation between the real wage and the unemployment rate

The AWSM consists of an increase in the real wage above the notional real wage accompanied by layoffs of excess workers. The rationale behind shifting to a new mechanism is the following: if workers use their high bargaining power to increase the real wage above the notional real wage, the firm decides to pay the increased wages in order to prevent shirking (as defined by Shapiro and Stiglitz, 1984), which would lead to reduced labor productivity[20]. *Ceteris paribus*, the surplus per worker left to the firm decrease, which is equivalent to a shock that 'unveils' the firm's efficiency reserves. To accommodate higher wage costs, the firm decides to use these reserves. Since efficiency reserves are limited, the AWSM is temporary. Unemployment rate rises according to equation (16) while production and the bargaining power remain unchanged as stated in equations (12) and (23), respectively.

The real wage a firm can pay to a worker without altering its own surplus per worker or the workers' surplus, when the unemployment rate increases according to equation (16), should satisfy the surplus maximization condition (18). In the absence of norms (z = 1) and taking into account the level of the bargaining power defined by equations (20)-(22) and that, at equilibrium, $D = Y$, $p = \overline{p}$, $L = 1 - u$, and $\overline{W}/\overline{p} = \eta(\beta - 1)/\beta$, the real wage that satisfies condition (18) is given by equation (30) adjusted, with η being replaced by η_{xef}.

[20] Here we assume that some firms cannot push up prices in order to accommodate wage increases. At least these firms use the efficiency reserves to preserve their surpluses.

The real wage given by the adjusted equation (30), in the absence of norms, is $I_\eta = \eta_{xef}/\eta$ times higher than the real wage indicated by equation (30), in the presence of norms. This means that when unemployment rate increases exclusively on account of excess workers layoffs, the real wage should grow by an index ($I_s = w_{s\,t}/w_{s\,t-1}$) equal to I_η in order for the surpluses of the firm and workers to remain maximum.

If $I_s = I_\eta$, the demand-related unemployment rate gap and the real marginal cost are preserved. This means that at the time of the AWSM adoption, the following changes occur at the level of the wage and the actual unemployment rate: $w_{st} = w_{st-1}\left[(1-u_{t-1})/(1-u_t)\right]$ (according to equation (17)), and $u_t = u_{t-1} + u^{xef}{}_{t-1}$ (according to equation (16)). Shifting to the AWSM is possible anywhere in the range $\left[u_{\min}, u^* - u^{xef^*}\right]$ if $u_t \le u_x \le u^* - u^{xef^*}$ or if $u_t \le u^* - u^{xef^*} \le u_x$.

4. The unemployment rate and inflation

In this section we introduce sticky prices in our model and investigate the implications of norms and of the AWSM on the relation between inflation and unemployment rate. In line with much of the recent literature on monetary business cycle models, we consider the sticky price á la Calvo (1983). Thus, in each period, only part of final producers ($1-\theta$), selected randomly, change their prices, while the remaining final producers (θ) keep prices unchanged:

$$\overline{p}^{1-\beta}{}_t = (1-\theta)\left(p_t^*\right)^{1-\beta} + \theta\left(\overline{p}_{t-1}\right)^{1-\beta} \tag{34}$$

where: p_t^* is the new price set by the firm at time t. The optimal rule of price setting for a firm that re-sets prices at time t is

$$E_t \sum_{i=0}^{\infty} \theta^i A_{t,t+i} (1-\beta)\left(\overline{p}_{t+i}\, p^*\right)^{-1} \left(p_t^* / \overline{p}_{t+i}\right)^{-\beta} C_{t+i}\left[p_t^* - \overline{p}_{t+i}\mu MC_{t+i}\right] = 0 \tag{35}$$

where: $A_{t,t+i} = \delta^i \left(C_{t+i}/C_t\right)^{-\sigma}$ is the discount factor, and MC is the real marginal cost.

From equations (34) and (35), after log-linearization around the steady state level of inflation rate equal to zero, we obtain the inflation rate (π)[21], which in view of equation (31) takes the form

$$\pi_t = \delta E_t \pi_{t+1} - \kappa\gamma\hat{u}_t \tag{36}$$

[21] A demonstration is provided by Carl E. Walsh (2003).

where: $\gamma\hat{u}_t$ is the deviation of the real marginal cost from its trend, $\hat{u} = u_t - u^*$ is the demand-related unemployment rate gap, $\kappa = (1-\delta\theta)(1-\theta)/\theta$, $E_t\{\pi_{t+1}\}$ is the inflation expected at t for $t+1$, and

$$\gamma = f\left(1-u^1_{min}\right)\left[\lambda_1\left(1-u^1_{min}\right)-1\right]/\left(1-u^*\right)^2 - \lambda_1\left[(1/\beta)+(1-s)\left(2u^* - u^1_{min}\right)\right].$$

Equation (36) represents the supply side of the economy. In the form presented herein, it relates the demand-related unemployment rate gap to inflation. In order for it to close, our model needs a demand equation. Following the steps indicated in Walsh (2003), it can be proved that the demand equation takes the form

$$b^{-1}\gamma\hat{u}_t = b^{-1}\gamma E_t\hat{u}_{t+1} - (1/\sigma)\left(r_t - E_t\pi_{t+1}\right) + \psi_t \quad (37),$$

where: $b = \sigma + \phi$, $\psi_t = \left[(1+\phi)/(\sigma+\phi)\right]\left(E_t\hat{\eta}_{t+1} - \hat{\eta}_t\right)$ depends only on exogenous productivity disturbances that impact demand and supply, such as a change in technology, and $\hat{\eta}_t$ is the deviation of labor productivity from its trend. Once the behavior of the nominal rate of interest is specified, equations (36) and (37) give a model for inflation and the unemployment rate gap, representing the general equilibrium conditions of the model.

Equation (36) allows us to show that the monetary policy effects on the unemployment rate- inflation relation depend on the presence/absence of norms. According to equation (14), the response of the unemployment rate to a change in the monetary policy stance is relatively large if employment is relatively high ($u_t < u_{nor}$) and norms are in place ($z = 0$). However, according to equation (15), the response of the unemployment rate is relatively low for low levels of employment ($u_t \geq u_{nor}$) or if norms are not in place ($z = 1$). The varying size of the unemployment rate response, which ultimately depends on the presence/absence of norms, can explain the counterintuitive fact that, sometimes (Fair, 1999), for relatively high levels of employment the Philips curve is relatively flatter[22].

To show the implications of the AWSM on the inflation-unemployment relation, we assume the economy is at the natural rate of unemployment. Adopting the AWSM means that the actual unemployment rate grows as described in equation (16) to its natural level, as required by equality (33). The real wage also increases from its low level given by equation (30) to the higher level $\eta_{xef}MC$. These increases in the unemployment rate and in the real wage leave the demand-related unemployment rate gap and thus the real marginal cost gap unchanged (both remaining equal to zero), having no impact on inflation. Equation (36) allows us to show that what happens to inflation depends on the trigger of the AWSM adoption.

[22] This could also explain some uncorrelated moves between the (natural) rate of unemployment and inflation, as shown by Tobin (1993), Eisner (1996), Galbraith (1997), Gordon (1997), Stiglitz (1997), Bernanke and Mihov (1998), Coen, Eisner, Marlin, Shah (1999), Ball and Mankiw (2002).

If the trigger is information asymmetry, inflation rate remains unchanged. The final result is a higher unemployment rate at the same inflation. However, a monetary policy easing aiming at bringing the unemployment rate back to the low level that preceded the AWSM adoption generates a negative demand-related unemployment rate gap, which in turn causes inflation to increase. As it is unsustainable at the new level, the unemployment rate returns to its natural level. Finally, the economy is functioning at relatively high levels of wages, inflation and unemployment rates. Wages and unemployment rates remain relatively high until the conditions for adopting norms are met again.

Alternatively, if the trigger of the AWSM adoption is an anticipation of a monetary policy easing, inflation expectations emerge and inflation increases due to the component $E_t \pi_{t+1}$ in equation (36). Thus, the anticipation of a monetary policy easing that leads to the AWSM adoption triggers the simultaneous growth of the unemployment rate and inflation. If no monetary policy decision is taken, real interest rate falls, causing aggregate demand to increase and the unemployment rate to temporally decrease before stabilizing to its natural level.

However, if the monetary authority confirms expectations by an actual policy easing that reverses the growth of the unemployment rate implied by the AWSM, the combined final result is only higher inflation since the unemployment rate increases back to its natural level. This result is in line with the results presented by Kidland and Prescott (1977), Baro and Gordon (1983) and others.

It is reasonable to assume that firms that change prices ($1-\theta$) choose to pass the wage growth to prices. In this case, the use of efficiency reserves is a gradual process. In a first stage, only firms that do not change prices (θ) adopt the AWSM. Thus, inflation and the unemployment rate will rise simultaneously. In the following stages, firms that did not use the efficiency reserves would want to use them as their competitors that did so choose to increase prices. This pushes the unemployment rate higher. However, because firms that change prices are selected randomly, it remains uncertain if inflation and the unemployment rate increase simultaneously in the following adjustment stages.

5. Conclusions

The model presented in this paper shows that if firms set norms that entail hiring auxiliary workers in excess and the workers' bargaining power depends on demand, then the negative relation between inflation and the unemployment rate can be temporarily interrupted. In the presence of norms, labor productivity, the unemployment rate and the real wage are relatively low. Besides the natural rate of unemployment, there are other levels of the unemployment rate that are relevant to monetary policy decisions.

The unemployment rate u_{nor}, below which firms set norms, is relevant to changes in labor productivity and to the effects on the unemployment rate of a change in the monetary policy stance. When the unemployment rate falls below u_{nor}, firms establish norms that entail excess workers. This produces a drop in both the unemployment rate, irrespective of changes in aggregate demand, and labor productivity. Conversely, when the unemployment rate becomes equal to (or higher than) u_{nor}, firms cancel norms. Workers in excess are dismissed, which determines an abrupt increase in the unemployment rate and pushes labor productivity to a higher constant level. Without norms, the unemployment rate becomes exclusively reliant on changes in aggregate demand. Thus, establishing/cancelling norms has consequences for macroeconomic policies. Monetary policy targeting a certain adjustment in the current inflation causes changes in the unemployment rate that are larger when norms are in place ($u_t < u_{nor}$), as compared to the opposite situation.

The unemployment rate at which the bargaining power of workers reaches a maximum, u_{min}, may be relevant to the inflation-unemployment relation and to monetary policy. Its relevance becomes manifest when the effective rate of unemployment is equal to (or lower than) the natural rate of unemployment and sufficiently close to u_{min}. *Ceteris paribus*, the lower the markup monopolistic firms add to the marginal cost, the lower the natural rate of unemployment, and thus the closer to u_{min}.

When these conditions are met, workers, by using their high bargaining power, can force the firm they work for to shift from a Nash-bargaining of wages to a temporary AWSM. This mechanism consists in increases in the wage beyond the notional wage (the workers have the power to impose this) accompanied by norms cancelation and layoff of all excess workers. The AWSM preserves the proportion to which a firm and its workers share the surplus associated with work relationships and interrupts temporarily the negative relation between inflation and the unemployment rate. Compared to their levels before the usage of efficiency reserves by firms, the wage, inflation, unemployment rate and labor productivity are relatively high until the condition for adopting norms is satisfied again.

The reason behind the AWSM adoption is relevant to the inflation-unemployment relation. In order to show this, we assume the economy is at the natural rate of unemployment. If the AWSM adoption is caused by insufficient information workers have regarding the size of the surplus associated with work relationships, the unemployment rate will increase without any change in the demand-related unemployment rate gap and inflation. However, if the AWSM adoption is determined by workers' expectations of monetary policy easing, inflation and the unemployment rate will increase simultaneously, while the demand-related unemployment gap will remain unchanged.

After dismissing excess workers, the inflation-unemployment rate relation turns negative again. In the short term, a monetary policy easing aimed at lowering unemployment rate back to the level seen before the usage of efficiency reserves increases the demand-related unemployment gap and, thus, inflation. As the unemployment rate is unsustainable at this level, it returns to its natural level.

Monetary policy should not seek to counterbalance the shock to the unemployment rate produced by norms' establishment/cancelation. However, in practice, it is difficult to identify those changes in the unemployment rate and labor productivity entailed by norms' adoption/cancellation.

The norms and the AWSM can explain in part why the relation between inflation and unemployment rate is mysterious in the sense suggested by Mankiw (2000). They support the idea that the inflation-unemployment relation is influenced by the interaction between monetary policy and the labor market. On the one hand, the labor market influences the monetary policy effects on the relation between inflation rate and unemployment rate. In our model this occurs due to norms. On the other hand, the labor market is impacted by expectations regarding changes in monetary policy stance. In our model, such expectations determine the AWSM adoption, which leads to the simultaneous growth of inflation and unemployment.

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