Sequential bargaining in a new-Keynesian model with frictional unemployment and staggered wage negotiation

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Abstract

We build a model with frictional unemployment and staggered wage bargaining and we assume that the two parties to the labor contract negotiate working time every period. We analyze the role of the workers bargaining power in the hours negotiation on unemployment volatility and inflation persistence. The closer to zero is this parameter, (i) the more firms adjust on the intensive margin, reducing employment volatility, (ii) the lower the effective workers’ bargaining power for wages and (iii) the more important is the hourly wage in the marginal cost determination. Combining staggered wage bargaining with a moderate workers’ power in the hours negotiation, we are able to produce realistic labor market statistics together with inflation persistence.

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1 Introduction

Real wage and labor market dynamics are crucial for understanding the inflation process. Standard new-Keynesian models contain only a highly abstract description of the labor market which does not allow for involuntary unemployment and real wage rigidity. Two keys issues that are central when monetary policy faces complicated trade-off decisions. Search and matching models, on the other hand, provide a more realistic framework that can be used to analyze unemployment and wage bargaining situations.

This explains the recent efforts to integrate frictional unemployment in new-Keynesian models with price and wage nominal stickiness. The initial expectation is that the combination of real and nominal wage stickiness is able to produce endogenous inflation persistence, while at the same time the search and matching frictions allow to produce realistic labor market statistics.

This research program faces two major difficulties. The first one is related to the labor market modelling: since the contributions of Hall (2005b) and Shimer (2004), it is known that the standard Diamond-Mortensen-Pissarides model is not able to produce the employment and vacancies observed volatilities. However, they also show that the introduction of wage rigidities for the newly created jobs allow to circumvent this difficulty. Following their insight, we adopt the Gertler and Trigari (2006) framework and model infrequent wage bargaining through a time dependent schedule à la Calvo. In addition, we allow nominal wage rigidity to be different for existing and newly created jobs. Indeed, these two types of rigidities have very different effects on the economy: the first one is especially important to reduce the wage volatility and enhance the inflation persistence while the second one is crucial for the volatility of the labor market variables.

A second difficulty arises from the combination of the search and matching set-up with nominal price stickiness. In the standard search and matching model, both capital and labor are predetermined and prices are the only source of flexibility in the short run. Such a market clearing role for prices is difficult to reconcile with the observed price stickiness and inflation persistence. Several solutions to this problem have been imagined so far. For example, some authors (e.g. Blanchard and Gali, 2006 or Gertler, Sala and Trigari, 2007) consider that employment can adjust instantaneously, with the inconvenient that it becomes a jump variable, in contradiction with empirical observation. Others (e.g. Trigari, 2004 and Walsh, 2005) consider endogenous job destruction with the drawback that most of the labor adjustment occur via the firing channel, in contradiction with the new hiring statistics.

An alternative solution on which the present paper focuses is the possibility for labor to adjust at the intensive margin, that is allowing individual working time to be modified along the business cycle. Several recent papers have worked on this idea\(^1\) which actually adapts the labor union literature about employment bargaining to endogenize the working time decision. Indeed, in the search and matching literature, unions have no direct influence on the hiring or

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firing process: firms decide alone whether to post a vacancy or not and most models consider exogenous job destruction. In this sense, the Diamond-Mortensen-Pissarides framework is close to the idea of ‘right-to-manage’ (Nickell, 1982). However, within the labor contract long-run relationship, it seems natural that any decision affecting the working time should be discussed by the two parties to the contract.

An important part of the literature on the intensive margin is developed under the assumption that hours and wage are re-bargained every period. In the present paper we want to analyze the consequences of combining staggered wage bargaining with continuously re-negotiated working time. Indeed, collective wage bargaining are observed to be infrequent, at least for institutional reasons. Given the medium-to-long run agreement reached for wage, the workforce can be adjusted along the business cycle. This adjustment can occur either on the extensive margin, which is a costly and time consuming process, or on the intensive margin, but in this case it is likely to involve some negotiation. This set-up is actually very close to the idea of sequential bargaining introduced by Manning (1987), the main differences being that (i) he considers employment instead of individual working time and (ii) his wage-employment sequential bargaining happens every period. For the rest, we also allow the bargaining power to be different in the wage and in the hours negotiations, following the intuition that the workers’ influence over different issues may vary widely.\footnote{This can be the case for institutional reasons. For example, in the United States, wages belong to the list of mandatory issues on which employers have to bargain with unions, while employment and working time are listed as permissive issues. As exemplified by Manning (1987), the legal structure can play an important role in differentiating the bargaining power by issues: “In the United States strikes at contract renegotiations about mandatory issues are legal, but strikes about permissive issues in the course of contracts are not”.}

This paper is certainly not the first one to combine flexible working time with time dependent wage bargaining. However, the sequential nature of the bargaining we discuss here displays at least two advantages. First, it is coherently built into the rules of the non-cooperative game theory. This is clearly not the case of the procedure used by Thomas (2007) where the infrequent non-cooperative nominal wage bargaining is based on the anticipation of a period-by-period cooperative working time decision. Second, it generalizes the Christoффel, Linzert and Kuester (2006) model where hours are unilaterally decided by the firm each period. The CLK (2006) model is obtained as a special case by setting to zero the workers’ bargaining power relative to the working time issue.

In order to assess the role of the sequential wage-hours bargaining we will compare our results with the two benchmark models mentioned supra. The Thomas (2007) model where hours are cooperatively decided has the advantage to be immune to the Barro’s critique (cf. Barro, 1977) since wage is not allocational for working time within the long-run labor contract relationship. This feature turns out to be also a drawback since it implies that there is no link anymore between wage and the marginal cost. Consequently, the real and nominal wage rigidities do not affect inflation persistence. On the opposite, leaving the working time decision entirely in the hands of the firm, as in CLK (2006) leads to a direct link between wage, working time and the
marginal cost. While it allows to obtain good performance from the inflation persistence point of view, it leads to very unsatisfactory results regarding the labor market statistics. Because of the huge flexibility given to firms, labor adjustments are mainly operated on the intensive margin, inducing unrealistic responses in hours and reducing strongly the employment volatility. We show that the sequential bargaining mechanism, by reducing the power of the firm, allows to circumvent this drawback without affecting the wage-inflation channel.

The paper proceeds as follows. Section 2 of the paper lays the model, focusing on the labor market. Apart from the labor market representation, the model encompasses the same structure and the same set of nominal and real rigidities as the workhorse new-Keynesian model (e.g. Smets and Wouters (2003, 2007) or Christiano, Eichenbaum and Evans (2005)). Section 3 discusses first the calibration on US data and then simulates the models to obtain the dynamic behavior they generate after a productivity and a monetary policy shock. In this section we assess in particular the ability of the models to match US data labor market statistics and to generate inflation persistence. The simulation exercise gives the opportunity to discuss the role of several parameters as the workers’ bargaining power in the hours negotiation, the Calvo probabilities to bargain respectively the wage of an existing and of a newly created job. Section 4 concludes.

2 The Model

The production side of the economy is exactly similar to Smets and Wouters (2003, 2007) or Christiano, Eichenbaum and Evans (2005). We therefore describe it only very briefly. The economy produces an homogenous final good and a continuum of intermediate goods. The final good serves for consumption and investment purposes. The final good sector is perfectly competitive; it produces an homogeneous good \( y \) by aggregating a continuum of intermediate goods indexed by \( i \) on the unit interval using a CES Dixit-Stiglitz technology

\[
y_t = \left[ \int_0^1 [y_t(i)^{\lambda_p}]^\frac{1}{\lambda_p} \, di \right]^{\lambda_p}.
\]

(1)

Each intermediate good is produced by a single firm and sold in a market characterized by monopolistic competition. Intermediate producers rent capital services \( \tilde{k} \) directly from the households and labor services \( l_t \) from labor firms and they combine these inputs using a Cobb-Douglas technology

\[
y_t(i) = \varepsilon_t^a \left[ \tilde{k}_t(i) \right]^\alpha [l_t(i)]^{1-\alpha}
\]

(2)

where \( \varepsilon_t^a \) represents total factor productivity modelled as an autoregressive process of order 1

\[
\varepsilon_t^a = \left( \varepsilon_{t-1}^a \right)^{1-\rho_a} \varepsilon_{t-1}^a \eta_t^a \quad \text{with} \quad \eta_t^a \sim iidN.
\]

As we assume constant returns to scale and price taking behavior on the input markets, the real marginal cost \( x_t \) is independent of the price and production levels and

\[
x_t = \frac{1}{\varepsilon_t^a} \left( \frac{\mu_t}{1-\alpha} \right)^{1-\alpha} \left( \frac{\tilde{k}_t}{\alpha} \right)^\alpha.
\]

(3)
where $\mu_t$ and $r^k_t$ represent the competitive price of labor services and capital services respectively.

We consider time-dependent price setting à la Calvo (1983). At each period, each intermediate good firm $i$ has a constant probability $(1 - \xi_p)$ to reset a new price. This price will prevail for $j$ periods with probability $\xi_p$. All the intermediate goods producers allowed to reset their selling price at time $t$ face exactly the same optimization problem and will therefore choose the same optimal price $p^*_t$. They fix it in order to maximize the expected flow of discounted profits. The producers forced to keep the same price index it on a weighted average of the past and trend inflation. These assumptions lead to the following log-linearized new-Keynesian Phillips curve for inflation $\pi_t$:

$$ (1 + \beta \gamma_p) \cdot \hat{\pi}_t = \beta \cdot E_t \hat{\pi}_{t+1} + \gamma_p \hat{\pi}_{t-1} + \frac{(1 - \beta \xi_p)(1 - \xi_p)}{\xi_p} \hat{x}_t $$

where hats denote variables expressed in percentage deviation from steady state. Parameter $\beta$ is the subjective discount factor and $\gamma_p$ represents the weight given to past inflation in the indexation process.

The labor input of the intermediate goods firms is produced by a continuum of one-worker labor firms that will be carefully described in section 2.2 infra. Let us simply say at this stage that the labor firms sell homogenous labor services on a competitive market to monopolistic intermediate producers. This model structure isolates the wage decision from the price decision. The rest of the section focuses on household and the labor market representation.

### 2.1 Households

Households consist of a continuum of workers indexed by $\tau$ on the unit interval. Workers supply an homogeneous type of labor, but only a proportion $n_t$ of them is employed. Furthermore, employed workers may receive different wages and differ in their worked hours due to labor market specificities that will be discussed in subsection 2.2.3 below. Because of our representative -or large- household interpretation, the unemployment rate $u_t$ is identical at the household and aggregate level. As exemplified by Merz (1995), the representative household assumption amounts to consider state contingent securities insuring workers against differences in their specific labor income. Family members share their labor income, i.e. wage and unemployment benefits, before choosing per capita consumption, investment, bonds holding and the degree of capacity utilization.

The representative household’s total real income is therefore equal to the aggregate income

$$ \gamma_t = \int_0^{n_t} w_t(\tau) \cdot h_t(\tau) \, d\tau + (1 - n_t) \cdot b + \left( r^k_t z_t - \Psi(z_t) \right) \cdot k_{t-1} + \Pi_t $$

The representative household total income is made up of the average labor income, the return on the real capital stock and the profits $\Pi_t$ generated by the monopolistic competitive intermediate producer firms. Average labor income is the sum of the average total wage -i.e. the integral of the individual hourly wage $w_t(\tau)$ multiplied by individual hours worked $h_t(\tau)$- and of the
unemployment benefit $b_i^3$ weighted by the employment-unemployment proportions. Households hold the capital stock $k_{t-1}$, a homogeneous production factor, and rent capital services to intermediate goods producers at the rental rate $r^k_t$. They can adjust the capital supply either by varying the capacity utilization rate $z_t$ or by buying new capital goods which take one period to be installed. The steady-state utilization rate is normalized to 1 and we assume that there is a cost $\Psi(z_t)$ associated with variations in the degree of capacity utilization

$$\Psi(z_t) = \frac{\omega}{1 + \zeta} \left[ z_t^{1+\zeta} - 1 \right],$$

so that $\Psi(1) = 0$ while parameter $\zeta$ represents the elasticity of the capital utilization cost function and $\omega$ is a scaling parameter. The capital accumulation process is as follows

$$k_t = (1 - \delta) \cdot k_{t-1} + \left[ 1 - \frac{\varphi}{2} \left( \frac{\Delta i_t}{i_{t-1}} \right)^2 \right] \cdot i_t,$$

where $i_t$ is the gross investment and $\delta$ the depreciation rate. We assume quadratic adjustment costs associated with changes in investment.

Households hold their financial wealth in the form of bonds $B_t$. Bonds are one-period securities with price $1/R_t$. The budget constraint faced by the representative household may be written as

$$\frac{B_t}{R_t \cdot p_t} + c_t + i_t = \frac{B_{t-1}}{p_{t-1}} + \gamma i_t \quad (6)$$

where $c_t$ represents aggregate consumption and $p_t$ is the price index.

We assume separability between leisure and consumption in the instantaneous utility function. Therefore, all the members of the representative household share the same marginal utility of wealth and choose the same optimal consumption, even though they do not spend the same amount of time at work. Adding external consumption habit effects, the household utility writes as

$$U(c_t, c_{t-1}, h_t(\tau)) = \log (c_t - e \cdot c_{t-1}) - \kappa_h \int_0^{\tau} [h_t(\tau)]^{1+\phi} d\tau \quad (7),$$

with $0 < e < 1$ and $\phi \geq 0$. Let $H_t$ be the value function of the representative household. If we momentarily leave aside the labor supply decision, its maximization program is

$$H_t = \max_{c_t, i_t, B_t, z_t} \{ U(c_t, c_{t-1}) + \beta \cdot E_t H_{t+1} \} \quad (8)$$

The consumer’s optimal decisions results in the following equations for the marginal utility of consumption $\lambda_t$, capital utilization rate, investment and the real value of capital $p^k_t$:

$$\lambda_t = E_t \left\{ \beta \cdot R_t \frac{p_t}{p_{t+1}} \right\} \quad (9),$$

$$r^k_t = \omega \cdot \zeta \quad (10),$$

$$1 = p^k_t \left[ 1 - \frac{\varphi}{2} \left( \frac{\Delta i_t}{i_{t-1}} \right)^2 \right] - E_t \left\{ p^k_t \frac{\varphi}{i_{t-1}} \frac{\Delta i_t}{i_t} - \beta \frac{\lambda_{t+1}}{\lambda_t} \frac{p^k_{t+1}}{p^k_t} \frac{\varphi}{i_{t+1}} \frac{\Delta i_{t+1}}{i_t} \left( \frac{i_{t+1}}{i_t} \right)^2 \right\}, \quad (11)$$

$$p^k_t = E_t \left\{ \beta \frac{\lambda_{t+1}}{\lambda_t} \left[ z_{t+1} \cdot r^k_{t+1} - \Psi(z_{t+1}) + (1 - \delta) p^k_{t+1} \right] \right\} \quad (12).$$

$^3$It could alternatively be interpreted as the income generated by the domestic activities of an unemployed worker.
2.2 Labor market

2.2.1 Labor market flows

We normalize the labor force to one, so that \( n_t \) represents at the same time the total number of jobs and the employment rate. This leads to the following accounting identity:

\[
\begin{align*}
n_t + u_t &= 1, \\
&= 1, \\
\end{align*}
\]

(13)

where \( u_t \) denotes the number of unemployed job-seekers. Let \( m_t \) denote the number of new firm-worker matches. We assume that the number of matches is a function of the number of job vacancies \( v_t \) and effective job seekers \( u_t \), and we consider the following linear homogeneous matching function:

\[
m_t = \theta_m v_t^\theta u_t^{1-\vartheta}.
\]

(14)

The probability for an unemployed worker to find a job is given by

\[
\mu_t = \frac{m_t}{u_t},
\]

(15)

while the probability that a firm fills a vacancy is

\[
\nu_t = \frac{m_t}{v_t}.
\]

(16)

An exogenous proportion \( s \) of firm-worker relationships ends up each period, which implies the following employment dynamics:

\[
n_t = (1 - s) \cdot n_{t-1} + m_{t-1}.
\]

(17)

2.2.2 One-worker hiring firms

As described supra, the labor hiring firms are perfectly competitive intermediaries renting labor services from households and selling these services to intermediate goods producers at a hourly rate \( \mu_t \). In this sense, their role is very similar to this of the labor packers in the traditional new-Keynesian model with staggered wage and walrasian labor market (see Erceg, Levin and Henderson (2000)). However, instead of aggregating differentiated types of labor, the role of the hiring firms is to seek and find workers in the pool of unemployed. Keeping the Mortensen and Pissarides (1999) assumption that they can hire at most one worker, we consider a continuum of hiring firms indexed by \( l \), with \( l \) distributed over the unit interval.

Labor efficiency is decreasing with hours, so that \( h \) hours supplied by one worker produce only \( h^\theta \) units of efficient labor, with \( \theta < 1 \). Consequently, hiring firm \( l \) produces either 0 or \( [h_t(l)]^\theta \) units of efficient labor and aggregate efficient labor can be computed as

\[
I_t = \int_0^1 [h_t(l)]^\theta dl = \int_0^1 h_t(l) dl.
\]

(18)

\footnote{This decreasing return to scale assumption is particularly important for the determination of the working time in the case firms decide it unilaterally.}
2.2.3 Time-dependent staggered wage setting and flexible hours

The hourly wage is assumed to be bargained between the hiring firm and its employee. However, the wage is not bargained again in every period since such negotiations are observed to be infrequent. According to this, we assume a time-dependent setting à la Calvo wherein each period only a fraction \((1 - \xi_w^o)\) of all existing wage contracts is renegotiated. All other nominal wages are simply adjusted for trend inflation \(\pi_t\).

Newly created jobs are paid either the previous period contract wage or the currently bargained wage with respective probabilities \(\xi_w^n\) and \((1 - \xi_w^n)\). The ‘previous period contract wage’ is a roundabout way to say that the actual wage is drawn out of the wage distribution prevailing at the previous period and indexed to trend inflation. As long as the draw is not realized, the expected wage of such a firm is equal to the indexed past average wage \(w_{t-1} \cdot \frac{\pi_{t-1}}{\pi_t}\). Note that for \(\xi_w^o = \xi_w^n\), this assumption is very close to considering a continuum of large firms, each firm paying the same wage to all its workers, as Gertler and Trigari (2006) do.\(^5\) However, allowing \(\xi_w^o \neq \xi_w^n\) gives somewhat more flexibility and will in particular prove useful when assessing the different roles played by nominal wage rigidity: \(\xi_w^n\) is particularly important to induce vacancies volatility while \(\xi_w^o\) helps to increase inflation persistence.\(^6\)

Finally, there is a growing literature reporting empirical evidence that the wage rigidity for new and existing jobs could be different (cf. Haefke et al. (2007), or Pissarides (2007)).

Even though the wage bargaining will be discussed in details infra, it is important at this stage to stress that all the ‘hiring firm-worker’ pairs that are given the opportunity to (re)-negotiate their wage contract face the same problem and therefore set the same wage. Because of the time dependent wage negotiation, workers may be paid different wages, even though they share the same productivity. Furthermore, given the bargained hourly wage, we allow the firm-worker pair some flexibility to react to unexpected shocks by adjusting the working time every period. The exact connection between hours and wage will be described in section 2.2.5 infra.

At this stage, let us simply assume that worked hours are a function of real wage. Formally, \(w_t^* \frac{\pi_{t-i}}{\pi_t}\) denotes the real value at time \(t\) of the nominal hourly wage negotiated \(i\) periods ago while \(h_t(w_{t-i}^*)\) represents the corresponding worked hours. From the employment dynamics equation (17), we may express the real value of the average total wage as

\[
h_t(w_t) \cdot w_t = \frac{n_t-1}{n_t} (1 - s) \cdot \left[ (1 - \xi_w^o) \cdot h_t(w_t^*) \cdot w_t^* + \xi_w^o \cdot h_t(w_{t-1}) \cdot w_{t-1} \cdot \frac{\pi_{t-1}}{\pi_t} \right] \\
+ \frac{m_{t-1}}{n_t} \cdot \left[ (1 - \xi_w^n) \cdot h_t(w_t^*) \cdot w_t^* + \xi_w^n \cdot h_t(w_{t-1}) \cdot w_{t-1} \cdot \frac{\pi_{t-1}}{\pi_t} \right]
\]

(19)

Noteworthy, in the particular case \(\xi_w^n = \xi_w^o = \xi_w\), i.e. if new jobs have the same probability to

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\(^5\)Actually the only difference would come from the ‘horizon effect’, i.e. the fact that with a continuum of large firms, the horizon of the labor contract of the worker is smaller than this of the firm since the latter continues its activity forever. In our one-job per firm set-up, firm and worker share the same horizon.

\(^6\)As illustrated by Bodart and al. (2005), there is a deep interaction between \(\xi_w^n\) and \(\xi_w^o\): the larger \(\xi_w^n\) is, the lower \(\xi_w^o\) has to be to induce the same vacancies volatility.
bargain their wage as existing jobs, expression (19) simplifies into

\[ h_t(w_t) \cdot w_t = (1 - \xi_w) \cdot h_t(w_t^*) \cdot w_t^* + \xi_w \cdot h_t(w_{t-1}) \cdot w_{t-1} \cdot \frac{\tilde{\pi}}{\pi_t}, \]

so that we have a microfounded wage equation similar to the equation of wage rigidities proposed in Blanchard and Gali (2006).

Developing recursively expression (19), we obtain the weight \( W_{t-i} \) associated with each wage \( w_{t-i}^* \) bargained in the past and its corresponding worked hours:

\[ W_{t-i} = \left[ \frac{n_{t-1-i}(1-s)}{n_{t-i}} (1 - \xi_{w}) + \frac{m_{t-1-i}}{n_{t-i}} (1 - \xi_{w}^o) \prod_{j=0}^{i-1} \left[ \frac{n_{t-1-j}(1-s)}{n_{t-j}} \xi_{w} + \frac{m_{t-1-j}}{n_{t-j}} \xi_{w}^n \right] \right], \]

The average worked hours \( h_t(w_t) \) is then simply computed as:

\[ h_t(w_t) = \int_0^{n_t} h_t(l) \, dl = \sum_{i=0}^\infty h_t(w_{t-i}^*) \cdot W_{t-i} \quad (20a) \]

### 2.2.4 Asset values of a job

Let us first adopt the viewpoint of a labor hiring firm. We denote \( A^{f}_{t}(w_{t-j}^*) \) the asset value in period \( t \) of a job with a wage that was bargained \( j \) periods ago. It will prove convenient to recast this value in marginal utility terms, multiplying it by \( \lambda_t \):

\[ A^{f}_{t}(w_{t-j}^*) = \lambda_t A^{f}_{t}(w_{t-j}^*) . \]

The value of a job expressed in marginal utility of consumption may then be written as

\[ A^{f}_{t}(w_{t-j}^*) = \lambda_t \left\{ h_t(w_{t-j}^*) \right\}^\theta \mu_t - h_t(w_{t-j}^*) \cdot w_{t-j}^* \cdot \frac{\pi^j p_{t+j}}{p_t} \right\} \\
+ \beta (1 - s) \, E_t \left[ (1 - \xi_{w}) A^{f}_{t+1}(w_{t+1}^*) + \xi_{w} A^{f}_{t+1}(w_{t-j}^*) \right]. \quad (21) \]

where \( \mu_t \) is the competitive price at which the hiring firm sells labor services to the intermediate goods firms.

If we now adopt the household viewpoint, the value of a job with a wage bargained \( j \) periods ago is given by

\[ V^{u}_{t}(w_{t-j}^*) = h_t(w_{t-j}^*) \cdot w_{t-j}^* \cdot \frac{\pi^j p_{t+j}}{p_t} - \kappa h_t(w_{t-j}^*) \frac{\left[ h_t(w_{t-j}^*) \right]^{1+\phi}}{1+\phi} \]
\[ + \beta (1 - s) \, E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left[ (1 - \xi_{w}) V^{n}_{t+1}(w_{t+1}^*) + \xi_{w} V^{n}_{t+1}(w_{t-j}^*) \right] \right\} \\
+ \beta s \, E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \, V^{n}_{t+1} \right\}. \]
where \( V_t^u \) represents the present value of being unemployed at period \( t \). In a formal way

\[
V_t^u = b + \beta \mathbb{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} (1 - j_t) V_{t+1}^u \right\} + \beta \mathbb{E}_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} j_t \left[ (1 - \xi_w^m) V_{t+1}^m(w_{t+1}^*) + \xi_w^m V_{t+1}^m(w_{t+1}) \right] \right\}
\]

and \( \mathbb{E}_t V_{t+1}^m(w_t) \) is simply the expected value of a next period new job if the wage of the latter is not bargained but drawn out of the previous period wage distribution. Defining \( A_t^h(\omega_{t-j}^*) \) as the household surplus in \( t \) expressed in marginal utility value for a job whose wage is bargained at time \( t \), i.e. \( A_t^h(\omega_{t-j}^*) = \lambda_t \cdot \left( V_t^m(\omega_{t-j}^*) - V_t^u \right) \), we can write

\[
A_t^h(\omega_{t-j}^*) = \lambda_t h_t(\omega_{t-j}^*) \left( \frac{\pi_j p_{t-j}}{p_t} - \kappa_h \right) V_t^m(\omega_{t-j})^{1+\phi} - \lambda_t b
\]

\[
+ \beta (1 - s) \mathbb{E}_t \left[ (1 - \xi_w^m) A_{t+1}^h(\omega_{t+1}^*) + \xi_w^m A_{t+1}^h(\omega_{t-j}^*) \right]
\]

\[- \beta \cdot j_t \cdot \mathbb{E}_t \left[ (1 - \xi_w^m) A_{t+1}^h(\omega_{t+1}^*) + \xi_w^m A_{t+1}^h(\omega_{t-j}^*) \right]. \tag{22}
\]

### 2.2.5 Wage and hours bargaining

As already pointed, all the renegotiating ‘hiring firm-worker’ pairs face the same problem and therefore choose the same wage \( \omega_{t-j}^* \). We assume that this wage is decided through a Nash bargaining procedure, i.e. it solves the following problem

\[
\max_{\omega_t} \left[ A_t^h(\omega_t^*) \right]^{\eta_w} \left[ A_t^l(\omega_t^*) \right]^{1-\eta_w} \tag{23}
\]

where parameter \( \eta_w \in (0, 1) \) represents the household’s bargaining power in the wage negotiation. The first-order condition implies the sharing rule:

\[
\eta_w \cdot A_t^l(\omega_t^*) \cdot \frac{dA_t^h(\omega_t^*)}{d\omega_t^*} = (-1) \cdot (1 - \eta_w) \cdot A_t^h(\omega_t^*) \cdot \frac{dA_t^l(\omega_t^*)}{d\omega_t^*}, \tag{24}
\]

with

\[
\frac{dA_t^h(\omega_t^*)}{d\omega_t^*} = \frac{\partial A_t^h(\omega_t^*)}{\partial w_t^*} + \mathbb{E}_t \sum_{i=0}^{\infty} \frac{\partial A_t^h(\omega_t^*)}{\partial h_{t+i}(\omega_t^*)} \frac{\partial h_{t+i}(\omega_t^*)}{\partial w_t^*} \tag{25}
\]

\[
\frac{dA_t^l(\omega_t^*)}{d\omega_t^*} = \frac{\partial A_t^l(\omega_t^*)}{\partial w_t^*} + \mathbb{E}_t \sum_{i=0}^{\infty} \frac{\partial A_t^l(\omega_t^*)}{\partial h_{t+i}(\omega_t^*)} \frac{\partial h_{t+i}(\omega_t^*)}{\partial w_t^*} \tag{26}
\]

The fact that the total derivatives with respect to wage depend on the sequence of expected hours worked reflects the assumption that working time is allowed to be adjusted every period.

**Cooperative hours determination** (cf. Thomas, 2007) In the case firms and workers decide to cooperatively set hours in order to maximize the period joint surplus, the working time is chosen to be

\[
h_t = \left( \frac{\theta}{\kappa_h \mu \lambda_t} \right)^{\frac{1}{1+\phi-\eta_w}} \tag{27}
\]
so that working time depend only on macroeconomic variables and wage is not allocational for
hours. Consequently, the two total derivatives (25) and (26) are identical but for the sign and the
optimality condition for the wage bargaining simply states that the household/firm intertemporal
surpluses ratio is equal to their relative bargaining power. From this expression, it is clear that
the competitive price of labor $\mu_t$ does only depend on worked hours and marginal utility of
consumption. It is absolutely not influenced by the average hourly wage and consequently, the
nominal wage rigidity of the existing jobs does not help increase the inflation persistence by
smoothing the marginal cost.

**Non-cooperative hours determination**  Let us now assume that, given the wage bargained
periods ago, the two parties to the contract seek to maximize their own period surplus through
a period-by-period hours negotiation. We allow the worker bargaining power $\eta_h \in (0, 1)$ in this
particular negotiation to be different from the one on wage ($\eta_w$):

$$
\max_{h_t} \left( h_t w^*_t - \frac{\pi^j_t p_{t-j}}{p_t} - b - \frac{\kappa_h}{\lambda_t} \frac{h_t^{1+\phi}}{1 + \phi} \right) \eta_h \cdot \left( h_t \mu_t - h_t w^*_t - \frac{\pi^j_t p_{t-j}}{p_t} \right)^{1-\eta_h} \tag{28}
$$

Defining

$$
F_t(w^*_t) = (1 - \eta_h) \cdot \left( h_t w^*_t - \frac{\pi^j_t p_{t-j}}{p_t} - b - \frac{\kappa_h}{\lambda_t} \frac{h_t^{1+\phi}}{1 + \phi} \right) \cdot \left( h_t \mu_t - h_t w^*_t - \frac{\pi^j_t p_{t-j}}{p_t} \right) 
$$

$$
+ \eta_h \cdot \left( \mu_h h_t^{\theta-1} - w^*_t - \frac{\pi^j_t p_{t-j}}{p_t} \right) \cdot \left( h_t w^*_t - \frac{\pi^j_t p_{t-j}}{p_t} - \frac{\kappa_h}{\lambda_t} \frac{h_t^{1+\phi}}{1 + \phi} \right), \tag{29}
$$

the first-order-condition is obtained for $F_t(w^*_t-j) = 0$.

In the particular case $\eta_h = 0$, the firm is left the right to manage working time and it
equalizes the marginal cost of one unit of time with its marginal revenue. At the other extreme,
if $\eta_h = 1$, the worker supplies labor in order to equalize the revenue of the marginal hour with
the disutility of it. The first derivative of hours with respect to wage is negative for $\eta_h = 0
and positive for $\eta_h = 1$. In between, it is monotonically increasing with $\eta_h$, implying that there
exists a value of $\eta_h$ such that the wage is not allocational for hours. For this particular value the
positive effect of a wage increase on labor supply is exactly compensated by the negative effect
on labor demand. This is made obvious by loglinearizing the first order condition $F_t(w^*_t-j) = 0
around steady-state:

$$
\hat{h}_t(w^*_t-j) = \left( \hat{w}^*_t-j + \hat{p}_{t-j} - \hat{p}_t \right) \cdot H_w + \hat{\mu}_t \cdot H_\mu + \hat{\lambda}_{t+j} \cdot H_\lambda \tag{30}
$$

with

$$
H_w = \frac{\bar{w} \bar{F}_w}{\bar{F}_h}, \quad H_\mu = \frac{\bar{\mu} \bar{F}_\mu}{\bar{F}_h} \quad \text{and} \quad H_\lambda = \frac{\bar{\lambda} \bar{F}_\lambda}{\bar{F}_h} \tag{31}
$$

where variables with a hat denotes percentage deviation from steady-state, the bar above a
variable indicates its steady-state value and $\bar{F}_j$ is the derivative of $F$ with respect to $j$. We can compute that

$$
\hat{F}_w = 0 \iff \eta_h = \frac{2 \hat{\bar{w}} - \bar{\mu} \bar{\theta} \bar{h}^{\theta} - \frac{\kappa_h}{\lambda} \frac{\hat{h}^{1+\phi}}{1 + \phi} - b}{\frac{\kappa_h}{\lambda} \frac{\hat{h}^{1+\phi}}{1 + \phi} + \bar{\mu} \bar{\theta} (1 - \theta) - \frac{\kappa_h}{\lambda} \frac{\hat{h}^{1+\phi}}{1 + \phi} - b}.
$$
As long as $\eta_h$ is different from this particular value, the competitive price of labor services $\mu_t$ is directly linked to the hourly wage, a feature some authors name the ‘wage channel’ (Trigari, 2006, Christoffel and Linzert, 2005). Since equation (30) holds for any wage, it is in particular valid for the aggregate hourly wage $w_t$ with the consequence that nominal and real wage rigidities will directly affect inflation persistence.

Noteworthy, in the case $\eta_h = 0$ studied by Christoffel, Kuester and Linzert (2006), we obtain

$$(-1)H_w = H_\mu = \frac{1}{1 - \theta}$$

and $H_\lambda = 0$

so that the link between wage and the competitive price of labor is one-for-one. However, this assumption that the firm is given the right to manage the working time leads to a huge variance of the distribution of individual worked hours: it is $(1 - \theta)^{-2}$ times higher than the variance of the distribution of wage.

This serious problem can be solved by increasing the household bargaining power in the working time negotiation. In order to show this, let us draw on Figure 1 the coefficients in the log-linearized hours equation as a function of the workers bargaining power on hours, $\eta_h$. Since a change in parameter $\eta_h$ implies a modification of the steady-state, this graph has been drawn numerically, using the same calibration as described in section 3.1 infra.\(^7\)

[insert Figure 1]

The first observation we can draw from Figure 1 is that the coefficients of the wage and the competitive labor price decrease rapidly and remain very close to each other in absolute value as $\eta_h$ increases away from zero. Therefore, an increase of the parameter $\eta_h$ helps to reduce strongly the impact of a change in the bargained wage on the variation (and distribution) of hours while at the same time, for a fairly wide range of values, it only weakly alters the wage channel.

2.2.6 Job creation and hiring costs

Let $A^n_t$ represent the asset value of a new job for the firm, which can be written as follows:

$$A^n_t = (1 - \xi^u_w) A^f_t (w_t^*) + \xi^u_w A^f_t (w_{t-1}).$$

(32)

The asset value of a vacant job $A^n_t$ is then given by:

$$A^n_t = -c^n_t + \beta \frac{\lambda_t + 1}{\lambda_t} \left[ q_t A^n_{t+1} + (1 - q_t) A^v_{t+1} \right],$$

(33)

\(^7\)However, contrarily to what is done in the simulation part, we keep parameter $\theta = 0.95$ for all values of $\eta_h$.\footnote{However, contrarily to what is done in the simulation part, we keep parameter $\theta = 0.95$ for all values of $\eta_h$.}
where \( c_v^t \) is the recurrent cost of opening a vacancy. We follow Yashiv (2006) and assume that the average cost per hiring\(^8\) is a linear function of the overall market hiring rate \( m_t/n_t \):

\[
\frac{c_v^t}{q_t} = \kappa \frac{m_t}{n_t}
\]

As Yashiv (2006) explains, this assumption emphasizes the cost of incorporating the newly hired workers in the labor force while with the fixed recurrent vacancy posting cost, the focus is on the search cost. From this perspective, we observe that the hiring cost is negatively correlated with employment. If a shock affects positively employment, the hiring cost decreases, which helps increase the expected profitability of a vacancy. This mechanism leads to more vacancy posting and it ends up in more employment via the matching function, so that the cost of one vacancy is durably decreased, leading to a high persistence in job creation.\(^9\)

Considering the free entry condition \( A_t^n = 0 \), equation (33) can be recast in:

\[
\kappa = \frac{n_t}{m_t} E_t \left\{ \beta \frac{\lambda_{t+1}}{\lambda_t} A_t^n \right\} . \tag{35}
\]

### 2.3 Market equilibrium and monetary authority behavior

The final good market is in equilibrium if production equals the demand augmented of the various adjustment costs. Households consume, invest and incur adjustment cost when adjusting the rate of capital utilization while hiring firms submit vacancy posting costs

\[
y_t = c_t + i_t + \Psi(z_t) \cdot k_{t-1} + c_v^t \cdot v_t
\]

The capital market is in equilibrium when the supply of capital services by the households satisfy the demand for capital of the intermediate goods producers.

The interest rate is determined by a reaction function that describes monetary policy decisions:

\[
R_t = \varepsilon_t^R \cdot R_{t-1}^{0.9} \left[ \frac{\pi_t}{\beta} \left( \frac{\pi_t}{\bar{\pi}} \right)^{1.5} \right]^{0.1}, \tag{36}
\]

where \( \varepsilon_t^R \) is an exogenous monetary policy shock specified as an i.i.d. normally distributed process. In this simplified Taylor rule, monetary authorities respond to deviation of inflation from its objective \( \bar{\pi} \).

### 3 Simulations and models comparison

We divide our simulation exercise in two different parts. In the first one, we examine the ability of the respective models detailed in the paper to reproduce second moments of the US labor market data after a productivity shock. In a second step, we compare the impulse response functions obtained for these various models after a monetary policy shock and examine in particular their ability to produce inflation persistence.

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\(^8\)Or in other words the cost of adjusting the workforce along the extensive margin.

\(^9\)This simple observation strongly contradicts the Gertler and Trigari (2006) claim that this vacancy cost assumption is innocuous.
3.1 Calibration

Table 1 displays the value of the parameters that are kept unchanged throughout the various variants of the model in the ensuing simulation exercise. In order to properly assess the high rate of job finding that characterizes the US labor market, we opt for a monthly calibration. The key parameters of the business cycle literature are calibrated at conventional values: the chosen discount factor implies an annual steady-state real interest rate of 4 percent, capital depreciates by 10% on an annual basis, the capital share is equal to 0.33 and the autocorrelation of the productivity shock is set at 0.95$^{1/3}$. Parameters related to the search and matching set-up, are mainly calibrated after Gertler and Trigari (2006). Since there is no strong evidence on the bargaining power, we assign equal power to both workers and firms ($\eta = 0.5$). As usual, the worker bargaining power on wage is equal to the match elasticity to unemployment ($\eta_w = 1 - \theta$).$^{10}$ The separation rate $s = 0.035$ is standard and supported by strong empirical evidences. The unemployment benefit $b$ is supposed constant and we assume that the replacement ratio (ratio between unemployment benefits and the average wage) is of 40 percent: $b = 0.4 \bar{w}$. We also impose that the job finding rate and vacancy filling rate are equal to 0.45 at the steady-state ($\bar{j} = \bar{q} = 0.45$). These restrictions yield the values of $m$ (matching efficiency) and $\kappa$ (fixed part of the vacancy opening cost). Parameter $\theta$ is adjusted so that the steady-state cost of adjusting the workforce is set at one percent of GDP.$^{11}$ Since we consider the role of the intensive margin, we also have to specify some specific parameters. The disutility parameter $\kappa_h$ is fixed in order to normalize the steady-state working time to 1 ($\hat{h} = 1$). The labor supply elasticity is fixed at 0.5, implying that parameter $\phi$ is set to 2, following the prior set on this parameter by Smets and Wouters (2005, 2007).

The parameters representing the real and nominal rigidities that are at the core of the new generation of monetary models are calibrated following the priors considered by Smets and Wouters (2005, 2007).$^{12}$ We set the habit formation parameter $\epsilon = 0.70$. We suppose a quadratic capital utilization cost ($\zeta = 1$) and we choose $\omega = 1/\beta - 1 + \delta$ to normalize steady-state capital utilization rate to 1. We assume an annual inflation of 2 percent, implying $\hat{\pi} = 1 + 0.02/12$. The elasticity of substitution between intermediate goods is assumed equal to 10, and the Calvo parameter for prices is $\xi_p = 0.87^{1/3}$ in order to reproduce the estimated elasticity of inflation with respect to the real marginal cost. Prices that are not reset may be indexed to past inflation or to trend inflation. We assume that the weight $\gamma_p$ of past inflation is 0.5. We follow Gertler and Trigari (2006) and set the probability to bargain the wage for an existing job at $\xi_w^o = 0.7^{1/3}$, implying that the average age of a wage contract is less than one year.

Finally, two parameters are set in order to match the US data. The probability to bargain

$^{10}$In a flexible model, this condition would guarantee an efficient equilibrium (Hosisos (1990) condition).

$^{11}$Imposing that the same proportion of GDP is devoted to the same employment adjustment cost in steady-state for all the variants of the model implies that we impose the same steady-state wage. However, equation (24) clearly displays that the wage bargaining will be very different from one variant to an other and should imply differences in the steady-state wage. In order to avoid this, we adjust parameter $\theta$ accordingly.

$^{12}$The quarterly parameters are transformed in monthly ones.
the wage of a newly created job, $\xi_{w}^{n}$, is fixed in order to fit the volatility of the US data labor market statistics (see Table 2 below). The investment adjustment cost parameter, $\varphi$, is set in order to match the relative volatility of investment with respect to output, i.e. for the chosen data described in the next section 2.43.

[insert Table 1]

### 3.2 Productivity shock

For the productivity shock, we mainly compare the ability of the various variants of our model to match second moments of US statistics. The US data we use for this exercise are the following: output, real hourly compensation, labor share, employment, unemployment, vacancies, hours, output per hour and output per person. All the series are quarterly data in the non-farm business sector from the BLS, but ‘unemployment’,\(^{13}\) which is a monthly series transformed into a quarterly one, and ‘vacancies’, which is the seasonally help wanted advertising index from the Conference Board, available at a monthly frequency and also transformed into quarterly data. We consider these data from 1966Q1 to 2005Q4. In order to fix the investment adjustment cost parameter, we use the investment series from the US Department of Commerce - Bureau of Economic Analysis databank.

All series are logged and HP-filtered with a 1600 smoothing weight. Their second moments are displayed in the second column of Table 2. The ensuing columns contain the statistics computed from the data generated after a productivity shock respectively by (i) a model with monopolistic labor and nominal wage stickiness, denoted hereafter MC, (ii) the model with sequential bargaining (hereafter SB), simulated for various values of the workers’ bargaining power in the hours negotiation and (iii) the model with cooperatively chosen hours (hereafter CH).

The first row of Table 2 present the chosen values of the workers’ bargaining power for the models with bargained hours. The second row displays for these values of the $\eta_{h}$ parameter the corresponding elasticity of the competitive price of labor with respect to wage. As it was already clear form Figure 1, the larger $\eta_{h}$, the lower the influence of wage on the marginal cost. In particular, for $\eta_{h} = 0.98$, this elasticity becomes zero, as in the model where hours are cooperatively chosen to maximize the joint period surplus. The third row is interesting as it presents the wage rigidity we need to impose on newly created jobs in order to reproduce the unemployment standard deviation relative to output. As we know since the work of Shimer (2004) and Hall (2005b), the more rigid the wage of the new jobs, the more vacancies and (un)employment are volatile. Noteworthy, the higher $\eta_{h}$, the less we need this type of rigidity to reproduce the relative volatility of the US labor statistics. This is good news since many voices arise to state that the wage of the new jobs is actually more flexible than this of existing jobs.

\(^{13}\)Seasonally adjusted unemployment level (16 year and over).
(cf. for example Haefke et al. (2007) and Pissarides (2007)). Interestingly, in the case $\eta_h = 0$, i.e. the case named ‘right-to-manage’ by some authors, we are never able to produce realistic unemployment relative volatility. This can be easily understood. When the firms are left free to optimize the working time, they will choose to ask a lots of hours to the workers with a relatively low wage and the other way round. In some sense, the adjustment along the intensive margin is so cheap and unconstrained that they have few incentive to adjust along the extensive margin. As $\eta_h$ increases, firms loose progressively this flexibility and eventually, in the cases wage is not allocational for hours (that is if $\eta_h = 0.98$ or if hours are cooperatively decided), all the workers provide the same working time, whatever their wage.

Note also that the bargaining power of the workers concerning their working time directly affects their effective bargaining power in the wage negotiation. For example, in the extreme case $\eta_h = 0$, workers internalize the fact that high wage requirements will end up in very low working time and this reduces the wage pressure. This mechanism is illustrated by the relative standard deviation of the hourly wage: the more wage is allocational for hours, the lower the volatility of the real hourly wage. While our models are rather good at matching the unemployment volatility, they have a harder job to produce enough total hours relative volatility. From this viewpoint the calibration of the sequential bargaining model with $\eta_h = 0.4$ is the best as it allows to match both relative standard deviations. For higher values of the hours bargaining power -and for the model with cooperatively chosen hours-, individual hours reverse too quickly to the steady-state as displayed by the serial correlation statistics. As already discussed, in the model with $\eta_h = 0$, it is the contrary that happens: individual hours are too volatile since the model is able to match the data relative standard deviation for this variable while at the same time it fails to reproduce employment relative volatility.

Finally, the model with sequential bargaining and the model with cooperatively chosen hours perform quite well with respect to the relative volatility of the hourly productivity and especially of the worker productivity. On the other side, these series display a too high correlation coefficient with output while their serial correlation is more in line with data. The sequential bargaining seems also particularly good at reproducing the co-movement between output and respectively the labor share, total hours and vacancies. Note that for the model with $\eta_h = 0.40$, this remark is also valid for unemployment.

3.3 Monetary policy shock

In the previous sub-section we merely focused on the labor market variables. Let us now concentrate on the ability of the various variants of our models to produce inflation persistence. In this exercise we choose the MC model as benchmark since it has already proved to perform well
on this aspect and we run our comparative analysis on the basis of impulse response functions after an unexpected drop of 1 percentage point in the (yearly) nominal interest rate.

Figure 2 focuses on the role of the $\eta_h$ parameter in the sequential bargaining model and illustrates the discussion of the ‘wage channel’. For this purpose we plot together the reactions of some variables after monetary policy shock for three values of $\eta_h$ (0, 0.4 and 0.98). Let us remember the aggregate variant of equation (30)

$$\mu_t = \frac{h_t}{H_\mu} - \frac{w_t}{H_\mu} - \lambda t \frac{H_\lambda}{H_\mu}$$  \hspace{1cm} (37)

together with Figure 1 that graphs the values of $H_w$, $H_\mu$ and $H_\lambda$ for the chosen calibration. From this, it is obvious that for the $\eta_h = 0$, the wage channel is wide open since $H_w/H_\mu = -1$. The value of the elasticity of the marginal cost with respect to wage is respectively 0.95 and 0 for the two other values of $\eta_h$. We observe that when $\eta_h = 0$, the model produces a huge inflation persistence. Indeed, the marginal cost is the leading variable for inflation dynamics in the new-Keynesian Phillips curve (4) and the competitive price of labor $\mu_t$ is the major component of the the marginal cost. For $\eta_h = 0$, the third term on the RHS of (37) vanishes. As mentioned earlier, the adjustment of the labor force occur mainly on the intensive margin but the importance of the movement in hours is counterbalanced by the weakness of its associated parameter in (37). Therefore wage is the main explanatory variable of $\mu_t$ and of the marginal cost. Furthermore, as explained supra, leaving firms the right-to-manage the working time when wage negotiations are infrequent strongly reduces the workers’ bargaining power in the wage negotiation, implying very sticky wages. As $\eta_h$ increases, \(i\) the bargaining power of the workers in the wage negotiation is enhanced, leading to a progressively less sticky wage, \(ii\) the aggregate wage coefficient in equation (37) gets (very progressively) smaller, \(iii\) aggregate individual hours react less strongly since more adjustment occurs along the intensive margin but the coefficient of this variable increases rapidly with $\eta_h$ and \(iv\) the role of the marginal utility of consumption increases even though it remains moderate because of the weakness of the associated parameter. These four elements go in the same direction and contribute together to generate more volatility in the competitive price of labor, and consequently in inflation.

It is also interesting to illustrate how parameter $\xi_w^\eta$, the Calvo parameter setting the probability that the wage of existing jobs is re-bargained, interacts with parameter $\eta_h$ to produce inflation persistence. This is the goal of Figure 3 which compares the effect of a drop from $\xi_w^\eta = 0.7^{1/3}$ to $\xi_w^\eta = 0.2^{1/3}$ in the cases $\eta_h = 0.4$ and $\eta_h = 0.98$. As already stated, parameter $\eta_h$ determines the opening of the so-called ‘wage channel’ while parameter $\xi_w^\eta$ helps to manage the wage stickiness. Obviously, in the case the wage channel is completely closed, i.e. if $\eta_h = 0.98$ (or if the wage is cooperatively chosen), the competitive price of labor is only marginally affected by a reduction of the probability to bargain the wage even though it leads to a much higher wage volatility. This feature is clearly an argument against the models without any wage channel since it is difficult to accept that variations in wage do not at all affect the price setting. On the contrary, from the moment the wage channel is open (illustration here is for the case $\eta_h = 0.4$), any element that affects the wage behavior modifies the inflation patterns in the same direction.
It is of course in particular the case of parameter $\xi_w^o$. It is also interesting to note from this Figure that there is a strong interaction between parameter $\xi_w^o$ and $\xi_n^w$. Indeed, the higher $\xi_w^o$, the smoother the dynamics of the expected wage for a newly created job and this feature is an incentive for vacancy posting and job creation. As $\xi_w^o$ is fixed at a lower value, this reduces the volatility of employment and individual hours have to vary much more. This higher volatility of aggregate individual hours is the main source of the small increase in inflation we observe when the wage is not allocational for hours and the Calvo probability to re-bargain an existing job increases.

Finally, it is striking from Table 1 and Figure 4 how the models characterized by a wage that is not allocational for hours produce very similar dynamics. From this observation, we conclude that our variant of the sequential bargaining model with a bargaining power of the workers on individual worked hours which is so strong that all the workers share the same working time is a good approximation of the Thomas (2007) model where hours are chosen in a privately efficient way to maximize the period surplus.

4 Conclusion

The present paper extends the literature on monetary models with search and matching frictions on the labor market. It is build upon the seminal work of Trigari (2006) and Christo¤el and Linzert (2005) on the direct link that opens in these models between wage and the marginal cost in the case firms are left free to manage their worker working time. As exemplified by Christo¤el, Kuester and Linzert (2006), this ‘wage channel’ allows to produce inflation persistence once stickiness is introduced in the wage setting process. These authors explored the path opened by Shimer (2004) and Hall (2005b) and imposing staggered wage bargaining. A priori, this should improve the performance of the model in reproducing labor market dynamics and lead to inflation persistence at the same time.

We clearly show that leaving the firms the right-to-manage the working time in a framework with staggered wage bargaining actually leads to an unrealistic volatility of the individual hours and too little volatility of employment. The reason is simply that firms can adjust for free along the intensive margin by asking the workers in the bottom of the wage distribution to work a lot. This generates an unrealistic distribution of individual hours and reduces strongly the effective bargaining power of the workers in the wage negotiation.

In order to counteract these pernicious effects, we propose to amend somewhat the model and give workers the possibility to affect the hours setting. For this we introduce a bargaining procedure on working time, the latter being activated every period in contrast with the infrequent wage bargaining. We show that reducing the firms’ prerogatives this way reduces their incentive to adjust along the extensive margin and helps to produce realistic labor market statistics. Furthermore, for a wide range of values of the workers bargaining power in the hours negotiation, the wage channel remains relatively strong which allows to obtain inflation persistence.
Finally, contrarily to Gertler and Trigari (2006) or Christo¤el, Kuester and Linzert (2006), we allow the wage of new entrants on the labor market to be more flexible than those of the existing jobs, following both intuition and recent literature (Haefke et al., 2007 and Pissarides, 2007). We show that this distinction is essential if we want to fine tune a model able to generate at the same time a realistic labor market and inflation persistence. Indeed, wage rigidity for the new entrants is important to generate a realistic amplitude of employment dynamics while wage rigidity for the existing jobs transmits into inflation persistence through the wage channel.

References


Appendix A: Figures and Tables

Figure 1: coefficients $H_w$, $H_\mu$ and $H_\lambda$ (equ. 30) as a function of $\eta_h$

Legend: $H_w$ is the solid line, $H_\mu$ is the dashed line and $H_\lambda$ the dotted line.

Numerical computation based on the calibration described at section 3.1.
The monetary policy shock is an unexpected drop in the yearly nominal interest rate by 1 ppt.

one period = one month
The monetary policy shock is an unexpected drop in the yearly nominal interest rate by 1 ppt.

one period = one month
Figure 4: Monetary policy shock - comparing CH and SB ($\eta_h = 0.98$)

The monetary policy shock is an unexpected drop in the yearly nominal interest rate by 1 ppt.

one period = one month
Table 1: Calibration common to all the variants (monthly)

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<tr>
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Table 2: Productivity shock - summary of statistics

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Relative standard deviation (w.r.t. output)

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<th>employment</th>
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Correlation with output

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<th>employment</th>
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<th>unemployment</th>
<th>vacancies</th>
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Serial correlation

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