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Wage setting actors and sticky wages: Implications for the business cycle and optimal monetary policy ☆

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ABSTRACT

Two sticky-wage models are introduced in this paper to examine the implications of having either households or firms as wage setting actors. The rate of wage inflation depends positively on the output gap if households set wages whereas such a relationship is of negative sign when firms set wages. Moreover, impulse–response functions and the statistical comparison with US data show different business cycle properties depending upon wage setting actors. Finally, optimal monetary policy is derived for each case, and compared with a Taylor-type monetary policy rule.

1. Introduction

In a highly influential article, Erceg et al. (2000) show how sticky wages can be modeled by giving households a fixed probability *à la* Calvo (1983) to optimally reset wage contracts.[1] Households own some differentiated labor services and may decide the nominal wage associated with their labor supply. The optimal wage can be reset only when receiving a market signal that arrives with a constant probability. In turn, the dynamics of wage inflation can be formulated in a single forward-looking equation. Fluctuations of wage inflation are governed by the gap between the households' marginal rate of substitution and the real wage. This sticky-wage structure is becoming very popular among New Keynesian researchers in recent times (Amato and Laubach, 2004; Smets and Wouters, 2003; Woodford, 2003; Giannoni and Woodford, 2004; Christiano et al., 2005; Levin et al., 2005; Casares, 2007).[2]

The analysis of this paper begins by describing a sticky-wage model where households set wages in an economy with perfect competition and flexible prices in the goods market. Alternatively, this paper switches the decision-making of the optimal wage from households to firms. As a result, wages may be set at the value that maximizes profit of a monopsonistically competitive firm.[3] In both models, nominal rigidities can be readily introduced as Calvo-style contracts with either households or firms being the wage setting actors.

Following Woodford's (2003) book and many New Keynesian papers, the output gap is the difference between current output and the amount of output that would prevail in the economy if nominal rigidities were dropped. Assuming sticky wages in the labor market and perfect competition in the goods market, the output gap in this paper is one endogenous variable that emerges from wage rigidities. Moreover, it will be shown how a forward-looking dynamic equation relates changes in the rate of wage inflation to those on the output gap. With households acting as wage setters, the output gap affects positively the rate of wage inflation. By contrast, if firms are the wage setting actors, the output gap has a negative impact on the rate of wage inflation. This paper also

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[1] The assumption of providing households with market power to set wages had already been taken in Blanchard (1986) and Rankin (1998).

[2] Analogously, a number of papers use Taylor (1980) staggered wage contracts set by households in a very similar optimizing framework. As representative examples, see Ascari (2000), Huang and Liu (2002), and Huang et al. (2004).

[3] Early contributions by Azariadis (1975), Hoehn (1988), and Flodén (2000) also put the wage setting decision on profit-maximizing firms.

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argues that the assumption of having either households or firms as setting actors in a sticky-wage model is not trivial for the business cycle analysis; impulse–response functions and second-moment statistics are significantly influenced by one case or the other.

The consequences of nominal rigidities on the optimal design of monetary policy were first examined in sticky-price models (Rotemberg and Woodford, 1997; Clarida et al., 1999). Such analysis was extended to the case of economies where both prices and wages were sticky by Erceg et al. (2000).[4] This paper discusses the optimal monetary policy when the only source of nominal frictions is wage stickiness.[5] In that respect, the monetary policy analysis will distinguish the implications of the two variants on wage setting actors, using welfare-theoretic targeting rules introduced by Woodford (2003, chapter 6). Furthermore, optimal policy will be compared with the case of having the central bank adjusting the nominal interest rate as prescribed by a Taylor (1993)-type simple rule.

The rest of the paper is organized as follows. The sticky-wage model where households set wages is described in Section 2. The case where firms are wage setting actors is introduced in Section 3 as another sticky-wage variant. Section 4 contains the model calibration and business cycle simulations based on impulse–response functions, and calculation of second-moment statistics to be compared with US data. The analysis of Section 5 is devoted to the theoretical monetary policy analysis. Finally, Section 6 reviews the main conclusions of the paper.

2. Households set wages (HSW model)

Since the publication of Erceg et al. (2000), sticky wages have been typically incorporated in the New Keynesian model by allowing households to set the nominal wage in the labor market. Hence, each household owns a differentiated labor service that supplies at some specific nominal wage. In this setup, firms demand bundles of labor services. A labor bundle is obtained using the aggregation scheme first described by Dixit and Stiglitz (1977)

$$n_t = \left[\int_0^1 (n_t(h))^{(\theta_h-1)/\theta_h} \mathrm{d}h\right]^{\theta_h/(\theta_h-1)}, \tag{1}$$

where $\theta_h > 1.0$, the time period is indicated in the subscript of the variables, and $n_t(h)$ is the labor service provided by the h-th household. The optimal substitution across labor services decided at the firm (i.e., the one that minimizes total labor costs) leads to the following labor demand equation regarding the h-th labor service[6]

$$n_t(h) = \left[\frac{W_t(h)}{W_t}\right]^{-\theta_h} n_t, \tag{2}$$

in which $W_t(h)$ is the nominal wage set by the h-th household, W_t is the Dixit–Stiglitz aggregate nominal wage,[7] and θ_h gives the constant elasticity of substitution across labor services. Also as in Erceg et al. (2000), let us assume that a separable CRRA utility function ranks the preferences of the h-th representative household over consumption, c_t, and the supply of labor, $n_t(h)$,

$$U_t(h) = \frac{\exp(\chi_t)(c_t)^{1-\sigma}}{1-\sigma} - \Psi\frac{(n_t(h))^{1+\gamma}}{1+\gamma}, \tag{3}$$

where χ_t is an AR(1) shock on consumption preference, $\chi_t = \rho_\chi \chi_{t-1} + \varepsilon_t^\chi$ with $\varepsilon_t^\chi \sim N(0,\sigma_{\varepsilon^\chi}^2)$. Consumption units, c_t, do not refer to the type of household because there are complete financial markets which make consumption identical across heterogeneous households. Intertemporal utility is maximized subject to budget constraints and labor demand constraints as displayed in the following optimizing program

$$\begin{aligned}
&\mathrm{Max}\, E_t \sum_{j=0}^{\infty} \beta^j \left[\frac{\exp\left(\chi_{t+j}\right)\left(c_{t+j}\right)^{1-\sigma}}{1-\sigma} - \Psi\frac{\left(n_{t+j}(h)\right)^{1+\gamma}}{1+\gamma}\right] \\
&\text{subject to :} \quad \frac{W_{t+j}(h)}{P_{t+j}} n_{t+j}(h) = c_{t+j} + \left(1+R_{t+j}\right)^{-1}\frac{B_{t+1+j}(h)}{P_{t+j}} - \frac{B_{t+j}(h)}{P_{t+j}} \text{ for } j = 0,1,2,\ldots \\
&\text{and to :} \quad n_{t+j}(h) = \left[\frac{W_{t+j}(h)}{W_{t+j}}\right]^{-\theta_h} n_{t+j} \text{ for } j = 0,1,2,\ldots
\end{aligned}$$

The budget constraint is expressed in real magnitudes; labor real income may be spent on units of consumption and on net purchases of bonds.[8] If nominal wages can be optimally reset every period, the first order condition with respect to $W_t(h)$ yields

$$\varsigma_t \frac{n_t(h)}{P_t} + \theta_h \xi_t \frac{n_t(h)}{W_t(h)} = 0, \tag{4}$$

that includes the Lagrange multipliers on the budget constraint, ς_t, and on the labor demand constraint ξ_t. The first order conditions for consumption and specific labor supply are

$$\begin{aligned}
&U_{c_t} - \varsigma_t = 0, \\
&U_{n_t(h)} + \varsigma_t \frac{W_t(h)}{P_t} + \xi_t = 0,
\end{aligned}$$

implying the following values of the multipliers[9]

$$\varsigma_t = U_{c_t} \text{ and } \xi_t = -\left(U_{n_t(h)} + \varsigma_t \frac{W_t(h)}{P_t}\right),$$

which can be substituted into the nominal wage optimality condition (4) to yield

$$\frac{W_t(h)}{P_t} = \frac{\theta_h}{\theta_h - 1}\frac{-U_{n_t(h)}}{U_{c_t}}. \tag{5}$$

The economic interpretation of Eq. (5) is straightforward: households choose the optimal nominal wage by applying a constant factor, $\frac{\theta_h}{\theta_h-1}$, to the real wage over the marginal rate of substitution (mrs) between disutility of labor and utility of consumption.

Following the fixed probability scheme used in Calvo (1983), nominal rigidities on wage setting are introduced assuming that households only reset optimally the wage contract in states of nature that arrive with a constant probability $1-\eta$. Therefore, households are not able to lay out the optimal wage contract with η probability. As in Casares (2007), the fraction of households who cannot set the optimal wage will apply the following stochastic indexation rule

$$W_t(s) = (1 + \pi^{ss} + \upsilon_t) W_{t-1}(s), \tag{6}$$

referred to some s-th suboptimal household. The indexation factor in Eq. (6) depends on the steady-state rate of inflation, π^{ss}, and also on the stochastic element, υ_t, which follows the AR(1) process $\upsilon_t = \rho_\upsilon \upsilon_{t-1} + \varepsilon_t^\upsilon$ with $\varepsilon_t^\upsilon \sim N(0,\sigma_{\varepsilon^\upsilon}^2)$. The υ_t term can be interpreted as a cost-push shock that will ultimately affect the rate of economy-wide wage inflation (as it will be shown below).

[4] See Woodford (2003, ch. 6), and Amato and Laubach (2004) for discussions on optimal monetary policy under other model settings.

[5] A number of empirical papers recently argue that prices are not as sticky as generally assumed (Golosov and Lucas, 2003; Bils and Klenow, 2004) and others put emphasis on sticky wages as the source of nominal rigidities in the economy (Christiano et al., 2005; Levin et al., 2005).

[6] See Erceg et al. (2000) for details.

[7] The Dixit–Stiglitz aggregate nominal wage is defined by $W_t = \left[\int_0^1 W_t(h)^{(\theta_h-1)/\theta_h}\mathrm{d}h\right]^{\frac{\theta_h}{\theta_h-1}}$ so that the amount of total labor costs obtained from all differentiated labor services supplied is the same as the total cost of bundles of labor, $\int_0^1 W_t(h) n_t(h)\mathrm{d}h = W_t n_t$.

[8] Regarding notation, E_t is the rational expectation operator, P_t is the aggregate price level, $B_{t+1}(h)$ is the nominal amount of bonds purchased in period t to be reimbursed in period $t+1$, and R_t is the nominal interest rate attached to such purchase.

[9] For simplicity in notation, U_{ct} represents the consumption marginal utility and $U_{nt(h)}$ the marginal disutility of labor.