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Interactions between Labor Market Reforms and Monetary Policy under Slowly Changing Habits

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Abstract

Although central banks often advocate labor market reforms, the latter may lead to higher stabilization costs in the presence of habit persistence in consumption. This is more likely to occur when strong habit persistence is coupled with an inflation-averse central bank.

The presence of habit formation is a non-negligible assumption: theoretically, it is now a well-established device used in New-Keynesian models in order to be data-consistent with the response of real spending to several shocks. Moreover, estimates of habit formation are, according to the literature, quite large.

To capture the interactions between monetary policy and structural reforms, our model improves on the one presented in Aguiar and Ribeiro (2008) by including a job matching process that introduces additional labor market features through which a labor market reform can operate. Within this framework, we assess, across different policy rules, how labor market institutional changes impinge on the effectiveness of monetary policy.

We have concluded that labor market reform reduces central banks' losses, as long as the degree of habit persistence is not too strong; however, alternative reform devices impinge differently on monetary policy effectiveness. Moreover, the inflation targeting rule accommodates positive permanent effects from the reform for a wider range of habit persistence.

Even when habit persistence is high, reform may still reduce stabilization costs if the importance of both demand and technology shocks is low relative to cost-push ones.

Keywords: Monetary policy rules; Labor market reform; Labor market search and matching; New-Keynesian models.

JEL Classification Codes: E24; E37; E52.

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1 Introduction

Using a reduction in the unemployment-benefit replacement ratio as a representative labor market reform, Aguiar and Ribeiro (2008) concluded that, in general, central banks gain from the reform as it permanently improves macroeconomic stabilization. However, they also concluded that negative effects may emerge for economies with a high degree of habit persistence coupled with a large relative weight put on price stabilization by the central bank. In this case, under simple (non-optimal) policy rules, a labor market reform may reduce monetary policy effectiveness.

In order to further inspect the conditions leading towards these results, we focus on the non-negligible role of habit persistence. On the one hand, habit formation in consumption is now a well-established device used in New-Keynesian models in order to be data-consistent with the response of real spending to several shocks. On the other hand, and from an empirical point of view, estimates for the habit-formation parameter are quite large, according to much of the literature. Estimates for the U.S., using quarterly data, are roughly above 0.7 (0.8 to 0.9 according to Fuhrer's, 2000, results, 0.73 in Boldrin *et al.*, 2001, 0.86 in Ravn *et al.*, 2006, and 0.67 in Sommer, 2007). As for the Euro area, Smets and Wouters' (2003) estimate is of 0.57.

Thus, an important issue is to access the habit-formation threshold level above which a reform may deliver negative effects to monetary policy effectiveness. Moreover, does this threshold level change with alternative instruments used to reform the labor market?

Theoretically, to capture the interactions between demand-side policies - monetary policy, in particular - and structural reforms, we follow a New-Keynesian rational-expectations framework with habit formation in consumption. The model improves on the one presented in Aguiar and Ribeiro (2008) by including a matching process between workers and vacancies posted by firms. By improving on the microfoundations to describe the labor market functioning, this framework introduces additional labor market features through which a reform can operate.

To illustrate the welfare effects of the reform, we use a calibrated version of the model, with parameters consistent with the Euro area macroeconomic environment. The characteristics of shocks hitting the economy and relevant features of labor market institutions are certainly heterogeneous within the Euro area. However, a simplified, standardized calibration for the Euro area - with a single monetary policy and some degree of coordination in the conduct of labor market reforms - is an interesting and useful example to illustrate the interactions between demand-side policies and structural reforms.

After this introductory section, the paper proceeds as follows. Section 2 briefly presents the macroeconomic model and identifies alternative stylized labor market reforms. In section 3, we assess the effects of the labor market reform on monetary policy. We start by arguing that different institutional changes impinge differently on the policy transmission mechanism. Next, we analyze to what extent habit formation is crucial for labor market reforms to deliver permanent welfare stabilization gains when the central bank mostly cares about price stabilization. Section 4 presents some concluding remarks.

2 The Model

In this section, we proceed with the description of a model designed to capture the interactions between labor market reform and monetary policy.

The model improves on the one presented in Aguiar and Ribeiro (2008) by including a matching process between workers and vacancies posted by firms. In addition to the unemployment protection or the relative bargaining power of the workers, this model also enables the analysis of reforms affecting both hiring and firing costs, as well as those improving the matching process.

With the exception of the description of the labor market functioning together with the identification of stylized labor market reforms, the rest of the model is only briefly described here.

2.1 Households

As in Aguiar and Ribeiro (2008), we consider an infinitely-lived risk-averse individual, representative of consumers' behavior. Enjoying utility from consumption and leisure, the representative household wishes to smooth both the level and the change in consumption, slowly changing habits.

$$\begin{aligned} &\underset{C_{t+j},GB_{i+j+1}}{Max} \quad E_t \sum_{j=0}^{\infty} \beta^{t+j} \left(Log \left[C_t(i) - hC_{t-1}(i) \right] \exp(g_t) - \frac{1}{1+\varphi} \right) \qquad (1) \\ &s.t. \quad C_{t+j} = \frac{\Pi_{t+j}}{P_{t+j}} + \frac{W_{t+j}}{P_{t+j}}(1-u_{t+j}) - GB_{t+j+1}\frac{1}{(1+rr_{t+j})} + GB_{t+j}. \end{aligned}$$

In the utility function, C stands for *per capita* consumption of a composite final good, g defines a shock to preferences, β $(0 < \beta < 1)$ is a discount factor and $h > 0$ stands for the index of habit persistence in consumption.

The inter-temporal budget constraint results from a weighted average of the constraints facing the employed and the unemployed and limits real consumption per period to the real income raised during current production activity plus the changes in holdings of real risk-free government bonds (GB). Production output is distributed either under the form of labor-related incomes or as profit earnings, Π. Given that the unemployment benefits are fully tax-financed by the employed, the real labor-related income for the representative agent simplifies to $\frac{W}{P}(1-u)$ in (1), where $\frac{W}{P}$ is the real wage rate and u stands for the unemployment rate.

The optimization problem leads to the following Euler equation for consumption that mimics the dynamics of the aggregate demand (*i.e.*, the IS function).

$$\begin{aligned} (1+\beta h^2)E_t\Delta y_{t+1} = \; & h\Delta y_t + \beta h E_t \Delta y_{t+2} + \\ & +(1-\beta h)(1-h)(r_t - E_t\pi_{t+1} - \rho) - \\ & -(1-h)(\upsilon_t - \beta h E_t \upsilon_{t+1}). \end{aligned} \qquad (2)$$

Where Δy_t is the change in the (log) of output, defined as $(y_t - y_{t-1})$, $r_t - E_t\pi_{t+1}$ defines the real interest rate (rr_t), and $\upsilon_t = -E_t\Delta g_{t+1}$ is a demand-side disturbance. The constant $\rho = -\log\beta$, $0 < \beta < 1$, is the time discount rate and corresponds to the steady-state equilibrium real interest rate.

2.2 Search, Matching and Job Destruction

The labor market is characterized by a continuous costly process of job search by workers and vacancy fill by firms. The latter must engage in costs to advertise and post vacancies, to screen workers and, eventually, to promote some training. The former also spend resources on collecting information and applying for a job. After successful matching, workers and firms engage in bilateral bargaining over gross nominal wages.

The way unemployed workers and job vacancies meet can be described by a matching function that produces m successful matches (in percentage of total labor force) per period, by randomly affecting unemployed persons (u, in percentage of total labor force) to vacancies (v, defined in the same terms):[1]

$$m_t = \varrho_m u_t^{\varrho} v_t^{1-\varrho} \tag{3}$$

The matching function is increasing in both arguments and exhibits constant returns to scale; $\varrho \, \epsilon \, (0,1)$ and ϱ_m is a scale parameter synthesizing all the factors that influence the efficiency of the matching process.

Given (3), the probability that any open vacancy is matched with a searching worker in period t is defined by q_t (vacancy matching rate); analogously, the probability that any worker searching for a job is matched with an open vacancy in period t is given by p_t (job finding rate):

$$q_t(\theta_t^l) = \varrho_m(\theta_t^l)^{-\varrho};\ p_t(\theta_t^l) = \varrho_m(\theta_t^l)^{1-\varrho},$$

where $\theta^l = \frac{v}{u}$, *i.e.*, the number of open vacancies relative to unemployed workers, measures the "market tightness".

However, a successful match is not held for a lifetime. Eventually, employed workers quit or get fired, feeding the unemployment pool. We will assume an exogenous job separating rate, λ_l, following Faia (2006) and Christoffel and Linzert (2005), among others. This assumption takes the flow into unemployment as arising from job-specific (idiosyncratic) shocks to matches that arrive at a Poisson rate λ_l and is consistent with the fact that the job destruction is rather constant over the business cycle (see, for instance, Hall, 2004).

Finally, we can describe the employment dynamics, evolving in accordance with the matching and separating flows just described:

$$N_{t+1} - N_t = q(\theta_t^l)v_t - \lambda_l N_t. \tag{4}$$

[1] As is often noted (see, for instance, Pissarides, 2000, and Christoffel and Linzert, 2005), the matching function compacts several sources of informational, locational frictions, or those deriving from heterogeneous agents, without explicitly referring to them.

where N stands for the employment level.

2.3 Collective Bargaining and Wage Setting

Assuming the existence of labor turnover costs (Lindbeck and Snower, 1988), which endow insiders with bargaining power relative to outsiders (unemployed), we consider that the workers of a given firm form a labor union to negotiate gross nominal wages alone, W_i. After the bargaining over wages, firms unilaterally choose the employment level - right-to-manage approach.[2]

For firm i, let J_i and V_i denote the present value of a job (filled vacancy) and the value of an open vacancy (unfilled vacancy), respectively. While the present value of vacancies remains positive, new vacancies are created until $V_i = 0$. For worker i, let E_i and U_i denote, respectively, the present value of being employed and unemployed. The corresponding flow values, subject to the employment dynamics (4) and the matching process (3), can be described as:

$$\begin{aligned} rJ_{it} &= (A_t - W_{it}/P_t) + \lambda_l(V_{it} - J_{it}) && (5) \\ rV_{it} &= -c + q(\theta_t^l)(J_{it} - V_{it}) && (6) \end{aligned}$$

$$\begin{aligned} rE_{it} &= W_{it}/P_t + \lambda_l(U_{it} - E_{it}) && (7) \\ rU_{it} &= b(W_{it-1}/P_{t-1}) + p(\theta_t^l)(E_{it} - U_{it}) && (8) \end{aligned}$$

Thus, firms and workers, engaged in a right-to-manage Nash bargaining process, will choose W_i optimally, *i.e.*, they will

$$\underset{W_{it}}{Max} \quad (J_{it} - V_{it})^{1-\Gamma} (E_{it} - U_{it})^{\Gamma}, \tag{9}$$

where Γ represents the workers' bargaining power. Assuming symmetry across firms, the optimal sharing rule is given by

$$(E_t - U_t) = \frac{\Gamma}{1-\Gamma} J_t, \tag{10}$$

and leads to the following wage offer curve:

$$\left(\frac{W}{P}\right)_t = \Gamma(A_t + c\theta_t^l) + (1-\Gamma) b \left(\frac{W}{P}\right)_{t-1}. \tag{11}$$

Log linearization of (11) around the steady state yields:

[2] According to Christoffel and Linzert (2005), the right-to-manage model seems to better characterize the institutional setup in Europe relative to other bargaining models, namely the efficient one.

$$
\begin{aligned}
\widetilde{(w-p)}_t &= (1-\Gamma)b\widetilde{(w-p)}_{t-1} + \omega_{s2}\Delta c_t + (1-\Gamma)\Delta b_t + \omega_{s3v}\widetilde{v}_t - \frac{\omega_{s3u}}{\alpha}\widetilde{y}_t + \omega_{s4}\Delta\Gamma_t, \qquad (12)\\
\textit{where} \quad \omega_{s2} &= \frac{1}{\overline{\left(\frac{W}{P}\right)}}\Gamma\overline{\theta^l};\\
\omega_{s3v} &= \frac{1}{\overline{\left(\frac{W}{P}\right)}}\Gamma c\frac{1}{\overline{u}};\\
\omega_{s3u} &= -\frac{1}{\overline{\left(\frac{W}{P}\right)}}\Gamma c\frac{\overline{v}}{\overline{u}^2};\\
\omega_{s4} &= \frac{1}{\overline{\left(\frac{W}{P}\right)}}\left[\overline{A} + c\overline{\theta^l} - b\overline{\left(\frac{W}{P}\right)}\right];\\
\Delta c_t &= c_{reform} - c, \quad \Delta b_t = b_{reform} - b, \quad \Delta\Gamma_t = \Gamma_{reform} - \Gamma;\\
\overline{\left(\frac{W}{P}\right)} &= \overline{\left(\frac{W}{P}\right)}(\Gamma, b, \overline{\theta^l}, c, \overline{A})
\end{aligned}
$$

where, and hereafter, variables with a line and a tilde hat denote the corresponding steady-state levels and deviations from the corresponding flexible-price levels, respectively.

2.4 Firms

Consider a continuum of intermediate goods producers indexed by $i \in [0,1]$, each of which produces a differentiated good, Y_i. When prices are optimally set (in order to maximize profits) at any period, the problem faced by the i^{th} firm can be represented by:

$$
\begin{aligned}
&\underset{v_{it}}{Max}\ \Pi_{it} = P_{it}Y_{it} - W_{it}N_{it} - P_t c v_{it} \qquad (13)\\
&s.t.\\
&Y_{it} = A_t\left(N_{it}\right)^{\alpha}, \quad \alpha < 1\\
&Y_{it} = \left(\frac{P_{it}}{P_t}\right)^{-\varepsilon} Y_t, \quad \varepsilon > 1\\
&N_{it+1} - N_{it} = q(\theta^l_t)v_{it} - \lambda_l N_{it}.
\end{aligned}
$$

where A is a technology index common to all firms, N_i refers to the hours of labor in use by the firm producing intermediate good i and Y_i represents the relative demand for each intermediate good i conditioned by the final good producers' optimal choice of inputs. The firm also faces costs for posting vacancies: workers are hired from the unemployment pool and the search for a worker involves a fixed (real) cost per open vacancy, c (for instance, costs for advertising, posting vacancies, screening and, eventually, training).

Finally, the last constraint refers to the employment dynamics (see equation 4 in 2.2 above). In particular, and given the production function, the employment dynamics can be re-written as

$$\alpha l_1 \widetilde{v}_t = \widetilde{y}_{t+1} + [l_2 - 1 + \lambda_l(1-\overline{u})]\widetilde{y}_t, \quad l_1 = l_1(\overline{v}/\overline{u}), \quad l_2 = l_2(\overline{v}/\overline{u}) \tag{14}$$

where $u = 1 - N$ and $\overline{v}$ and $\overline{u}$ refer to the steady-state values of the vacancy and of the unemployment rates, respectively.

Under a competitive set-up, both the composite final good, Y, and the corresponding general price index, P, can be defined as a Dixit and Stiglitz (1977) CES-type aggregation of intermediate goods production and prices, respectively.

Assuming symmetry across firms, $P_i = P$ and $Y_i = Y$, the solution to (13), above, defines the aggregate price as a constant mark-up, μ, of prices over nominal marginal costs (the flexible-price (FP) decision by firms):

$$P_t = \mu \left[\left(W_t + \frac{P_t c \lambda_l}{q(\theta_t^l)} \right) \left(\frac{1}{\alpha} Y_t^{\frac{1-\alpha}{\alpha}} A_t^{-\frac{1}{\alpha}} \right) \right], \quad \mu = \frac{\varepsilon}{\varepsilon - 1}, \quad \alpha < 1, \quad \varepsilon > 1. \tag{15}$$

Because the assumption that firms can optimally reset prices at any period is not compatible with real effects of the demand-side policies, we follow the price adjustment mechanism as proposed in Galí (2003): in each period, firms adjust prices optimally with probability $(1-\theta)$, independent of when prices were last adjusted and conditioned upon the expected average duration of price stickiness.

The optimal price-setting decision can be expressed in the following approximate log form, which describes the aggregate supply (AS) function.

$$
\begin{aligned}
\pi_t &= \beta E_t\left\{\pi_{t+1}\right\} + \lambda\left[\omega_1(\widetilde{w-p})_t + \left(\frac{1-\alpha}{\alpha} - \frac{\omega_{3u}}{\alpha}\right)\widetilde{y}_t + \omega_2\Delta c_t + \omega_{3v}\widetilde{v}_t\right] + \mathtt{u}_t, \qquad (16)\\
\textit{where}\quad \lambda &\equiv \frac{\alpha(1-\theta)(1-\theta\beta)}{\theta\left[\alpha+\varepsilon\left(1-\alpha\right)\right]};\\
\omega_1 &= \frac{1}{z}\overline{\left(\frac{W}{P}\right)};\\
\omega_2 &= \frac{1}{z}\frac{\lambda_l}{q(\overline{\theta^l})};\\
\omega_{3u} &= -\frac{1}{z}c\lambda_l\frac{1}{\overline{\left(\frac{W}{P}\right)}^2}\varrho_m\varrho\left(\frac{\overline{v}}{\overline{u}}\right)^{-\varrho-1}\frac{\overline{v}}{\overline{u}^2}\\
\omega_{3v} &= \frac{1}{z}c\lambda_l\frac{1}{\overline{\left(\frac{W}{P}\right)}^2}\varrho_m\varrho\left(\frac{\overline{v}}{\overline{u}}\right)^{-\varrho-1}\frac{1}{\overline{u}};\\
\textit{with}\quad z &= \overline{\left(\frac{W}{P}\right)} + \frac{c\lambda_l}{q(\overline{\theta^l})}\\
\Delta c_t &= c_{reform} - c;\quad \overline{\left(\frac{W}{P}\right)} = \overline{\left(\frac{W}{P}\right)}(\Gamma, b, \overline{\theta^l}, c, \overline{A}).
\end{aligned}
$$

with π being the inflation rate and $E_t\pi_{t+1}$ standing for the expected inflation rate in period $t+1$, conditional on the information available at time t.

This AS function reflects the usual positive relation between inflation and the output gap and includes real wage inertia (recall equation 12 above) in price determination. The term $\mathtt{u}_t$ represents a cost-push shock, including unexpected labor market institutional changes.

2.5 Steady-State Equilibrium and the Flexible-price Dynamics

The wage offer curve (equation 12) together with the labor demand under flexible prices (equation 15) and the employment law of motion (equation 14) enable the determination of the steady-state equilibrium.

Combining equations (15) and (12), the steady-state real wage is given by

$$
\overline{\left(\frac{W}{P}\right)} = \frac{\Gamma(\overline{A} + c\overline{\theta^l})}{[1-(1-\Gamma)b]}, \qquad (17)
$$

which leads to the following steady-state labor demand (= steady-state employment rate):

$$(1-\overline{u}) = \left[\mu\left(\overline{\left(\frac{W}{P}\right)} + \frac{c\lambda_l}{q(\overline{\theta^l})}\right)\left(\frac{1}{\alpha}\overline{A}^{\frac{1-\alpha}{\alpha}}\right)\right]^{\frac{1}{\alpha-1}}, \mu = \frac{\varepsilon}{\varepsilon-1}, \alpha < 1, \varepsilon > 1. \quad (18)$$

where $\overline{u}$ is defined, using the employment dynamics (14), as

$$\overline{u} = \frac{\lambda_l}{\lambda_l + q(\overline{\theta^l})\overline{\theta^l}} = \frac{\lambda_l}{\lambda_l + p(\overline{\theta^l})} \quad (19)$$

with

$$\overline{\theta^l} = \frac{\overline{v}}{\overline{u}}. \quad (20)$$

Thus, the corresponding level of steady-state output is

$$\overline{y} = -\alpha\overline{u}, \quad (21)$$

a non-efficient level of output, *i.e.*, the highest output level that can be achieved through demand-side policies without creating inflation bias.

Since real marginal cost is constant under flexible prices ($= \frac{1}{\mu}$), $\left(\frac{W}{P}\right)_{t-1} = \left(\frac{W}{P}\right)_t = \overline{\left(\frac{W}{P}\right)}$, the flexible-price output level can be defined as:

$$\overline{y}_t = -\alpha\overline{u} + a_t. \quad (22)$$

2.6 Stylized Labor Market Reforms

Labor market reforms have two major positive macroeconomic effects: by increasing real wage flexibility, (i) reforms improve stabilization of cost-push shocks and (ii) reduce equilibrium unemployment, thus increasing the flexible-price output (Saint-Paul and Bentolila, 2001). Crucially, the former effect influences the transmission mechanism of demand-side policies - and, in particular, that of monetary policy - and thus, impinges on the effectiveness of policy as a macroeconomic stabilization device.

In the model described throughout, the unemployment-benefit replacement ratio (b), the workers' bargaining power (Γ), the efficiency of the matching process (ϱ_m), the fixed (real) cost per vacancy (c) and the job separating rate (λ_l) are specific institutional features characterizing the functioning of the labor market. From the steady-state results, it is clear that these structural parameters affect equilibrium unemployment. Straightforwardly, a reduction in the unemployment benefit or in the workers' bargaining power - reducing the bargained nominal (real) wage -, an increase in ϱ_m - increasing the job finding rate - and a reduction in c - increasing labor demand - are expected to reduce the equilibrium unemployment rate. As for λ_l, a reduction in the job destruction rate has, according to the literature, ambiguous effects on unemployment (see, among others, Layard *et al.*, 1991). On the one hand, legislation reinforcing employment protection, for instance, by reducing exposure to unemployment, pushes wages up and thus puts upward pressure on the unemployment rate. On the other hand, permanent inflows to unemployment are reduced and, consequently, equilibrium unemployment diminishes. In fact, our model captures only the latter effect (λ_l is absent from the wage offer curve, in equation 11) and thus λ_l is positively related to equilibrium unemployment.

Since these institutional features are related to the equilibrium unemployment rate, we take them as alternative instruments for labor market reform. For simplification, we identify stylized labor market reforms with changes in these parameters that imply a reduction in the steady-state equilibrium unemployment rate, *i.e.*, that improve labor market flexibility.

2.7 Monetary Policy

Benevolent policy authorities aim at maximizing a theoretical, model-specific, welfare function of the representative agent. In practice, as usually argued in the literature, central banks fail to design and implement such optimal policy rules (Taylor, 1999, and Galí, 2003, among others). To account for this, several authors have proposed a variety of simple rules as guidelines for implementation of monetary policy and have assessed their performance across different models. These simple rules can, in general, be summarized in the following instrument rule (*e.g.*, McCallum, 2001):

$$r_t = (1-\rho_r)\left[\rho + \phi_\pi \pi_t + \phi_y (y_t - \overline{y}_t)\right] + \rho_r r_{t-1} + \varepsilon_{rt} \qquad \phi_\pi, \phi_y > 0, \quad \rho_r \in (0,1)\,, \quad (23)$$

where r stands for the nominal interest rate, π for the inflation rate (assuming a zero-inflation target), ρ is the constant steady-state real interest rate, ρ_r stands for the nominal interest rate smoothing parameter, and ε_r denotes a monetary policy shock. This Taylor-type rule (TR) is successful in mimicking central banks' behavior, and it exhibits good properties relative to the optimal policy (see the studies in Taylor, 1999).

In particular, we use the general form of interest rate reaction function embedded in equation (23) to illustrate different policy regimes running from the strict inflation targeting ($\phi_\pi > 0, \phi_y = \rho_r = 0$) to the TR with and without smoothing ($\phi_\pi, \phi_y, \rho_r \geq 0$).

In the following section, we simulate the effects of the stylized reforms on both the transmission mechanism and on the effectiveness of monetary policy, across different policy rules. Simulations are computed using the calibration exhaustively described in the Appendix.

3 Effects of a Labor Market Reform on Monetary Policy

As we have already mentioned, one of the benefits accruing from a labor market reform is to potentially improve the stabilization role of demand-side policies, in particular that of the monetary policy. Using the framework described above, we propose to assess the effects of a reform on the transmission mechanism and thus on the effectiveness of monetary policy. In particular, we focus on how habit formation shapes these effects for an inflation-averse central bank.

3.1 Monetary Policy Transmission Mechanism

In order to exemplify the effects on the policy transmission mechanism, we compute the responses of the output gap and of the inflation rate to a positive 1 percentage point shock in the nominal interest rate (ε_r), comparing the adjustments under alternative labor market structures. In particular, we consider alternative values for b (0.4 and 0.6), for Γ (0.1 and 0.5) and for λ_l (0.047 and 0.09).[3] The illustrative impulse responses depicted in Figures 1 to 3 were computed using the TR with smoothing and with h set at 0.5.

With the exception of the exit rate, a more flexible labor market (solid lines) improves the ability of the interest rate to better stabilize inflation relative to the output gap. Results not reported show that these adjustments can also be seen if the matching process becomes more efficient (higher ρ_m). However, the opposite occurs if exit rates are lowered. Our results contrast with those in Christoffel and Linzert (2005) where a reduction in the workers' bargaining power reduces the ability of the interest rate to stabilize both the unemployment and the inflation rate; moreover, a reduction in λ_l diminishes the impacts on output and amplifies those in inflation, following a monetary policy shock. However, our results match, qualitatively, those reported in Christoffel *et al.* (2009) for the case of a reduction in the unemployment benefit. Our results seem to be also in line with Trigari's (2004): when comparing the search model with the baseline (competitive labor market) New-Keynesian framework, a monetary policy shock under a more rigid labor market design induces lower inflation volatility while it amplifies output's. In fact, a reform amplifying the response of costs to changes in output reduces the sluggishness in price adjustment and leads to lower output variability.

Our results also show that rigid labor markets induce additional persistence in the economies, making the effects of shocks more permanent: lower sensitivity of the price level to output increases the persistence of the response of the output gap to a monetary shock.

In regard to policy implications, the results show that (i) the labor market functioning influences the monetary policy transmission mechanism; this is particularly relevant when a common monetary policy applies to several countries that may exhibit important institutional differences (for instance, within the EMU). Moreover, and regarding monetary policy effectiveness, (ii) a labor market reform improves macroeconomic stabilization in face of cost-push shocks. Inspection of Figures 1 and 2 shows that monetary policy improves inflation stabilization at a lower output cost under a more flexible labor market. However, (iii) in face of demand-side shocks, such as the one exemplified by the monetary policy itself, welfare stabilization costs may increase with the reform because of higher inflation volatility. If monetary policy were to be optimally implemented, reform would, in fact, reduce stabilization costs. In the case of non-optimal policy rules, welfare costs arise from incomplete accommodation to technology and demand-side shocks. In this latter case, and exclusively focusing on a reduction in the unemployment-benefit

[3] The changes in the parameters are not those reported in the Appendix. Here, and for the sake of a better graphical illustration, differences towards baseline values are larger.

replacement ratio, Aguiar and Ribeiro (2008) show that, for high values of habit persistence, the reform can even increase stabilization costs for an inflation-averse central bank.

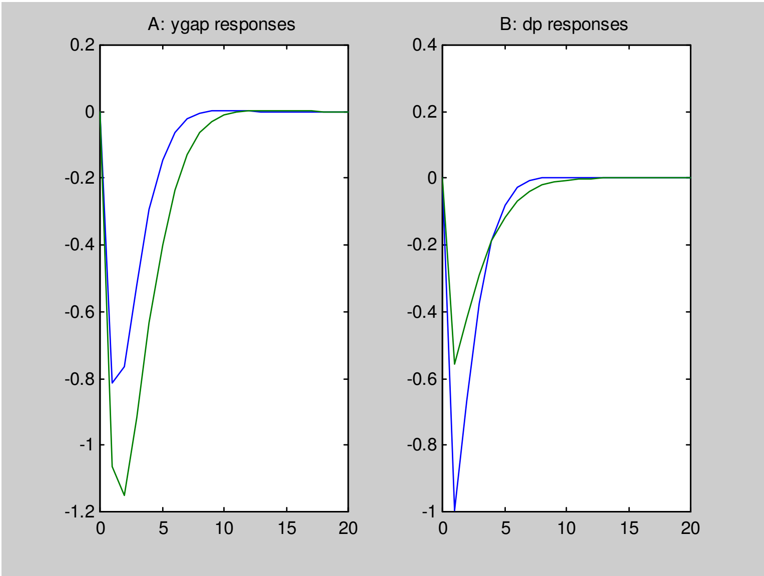

Figure 1: Responses to a 1 percentage point rise in the nominal interest rate - high b (dotted lines) vs low b (solid lines).

Thus, if demand and technology shocks dominate, reforms may worsen stabilization costs. The latter are expected to increase with the persistence of shocks and with the preferences of the central bank (CB) for inflation stabilization relative to output-gap stabilization. Additionally, the presence of habit persistence in consumption appears to be a key determinant in how labor market reforms affect the stabilization role of monetary policy. In this context, we aim to explore the consequences of labor market reforms on monetary policy effectiveness, under these relevant scenarios.

3.2 Monetary Policy Effectiveness

In the remainder of this section, and given the former illustrative results, we intend to evaluate under which conditions an inflation-averse CB should argue in favor of a reform. In particular, in an environment characterized by habit formation and taking the three alternative non-optimal policy rules (see 2.7, above), we i) rank the different instruments for a labor market reform, according to their permanent effects on macroeconomic stabilization and ii) fully test how the reform impinges on monetary policy effectiveness across several degrees of habit persistence.

To evaluate the permanent effects on stabilization costs we need to evaluate the infinite horizon intertemporal Loss function of the CB, for given properties of the several

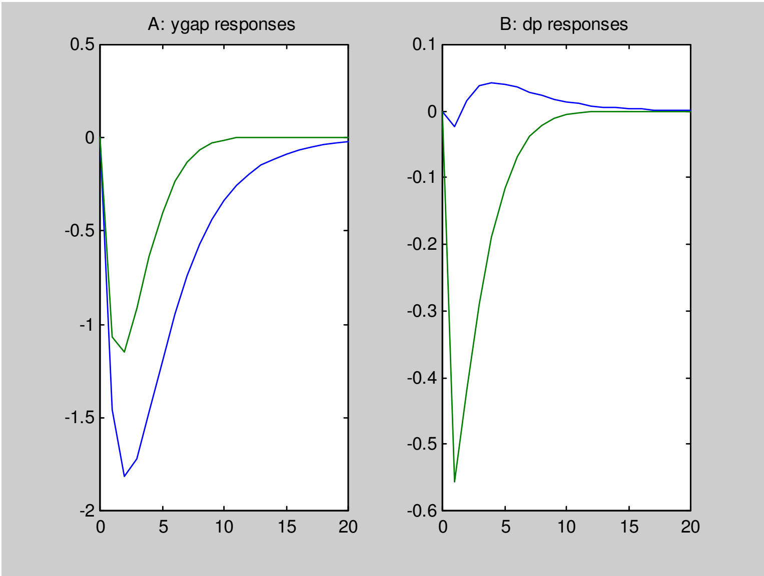

Figure 2: Responses to a 1 percentage point rise in the nominal interest rate - high Γ (dotted lines) *vs* low Γ (solid lines).

shocks hitting the economy. For this purpose, we take the following re-scaled Loss function, as proposed in Rudebusch and Svensson (1999). With $\beta \to 1$,

$$\lim_{\beta \to 1}(1-\beta)(L) = E(L_t) = var(\pi_t) + \omega_y var(\widetilde{y}_t). \tag{24}$$

Where L_t stands for the period Loss function, $L_t = \pi_t^2 + \omega_y \widetilde{y}_t^2$, and $L = E_0 \left[\sum_{t=0}^{\infty} \beta^t (L_t) \right]$.

In order to evaluate $E(L_t)$, the variability of output-gap and inflation must be determined conditional upon the variability of the shocks. Following the standard practice, we consider the existence of three types of shocks: (i) demand-side (υ_t) and (ii) cost-push (u_t) shocks (recall equations 2 and 16, respectively), assumed to follow a white-noise process with zero mean and standard-deviations of σ_υ and σ_{u}, respectively; and (iii) a temporary technology shock , a_t (equation 22), modeled as a first order autoregressive process (autocorrelation parameter, ρ_a), with innovation characterized by a zero mean and standard-deviation of σ_a.[4] The values for the parameters characterizing these processes are presented in the Appendix. To compute the CB Loss, we have analytically determined the second moments of the endogenous variables, applying the asymptotic formulas presented in Hamilton (1994, pp. 264-6).

Figures 4 to 6 show, for different policy rules and across several degrees of habit formation, the permanent effects on the CB Loss when the unemployment-benefit replacement ratio is reduced from 0.7 to 0.6 (green lines). Under our calibration, this reduces the

[4] The temporary nature of the technology shock is appropriate in the context of macroeconomic stabilization (see, for instance, McCallum and Nelson, 2004).

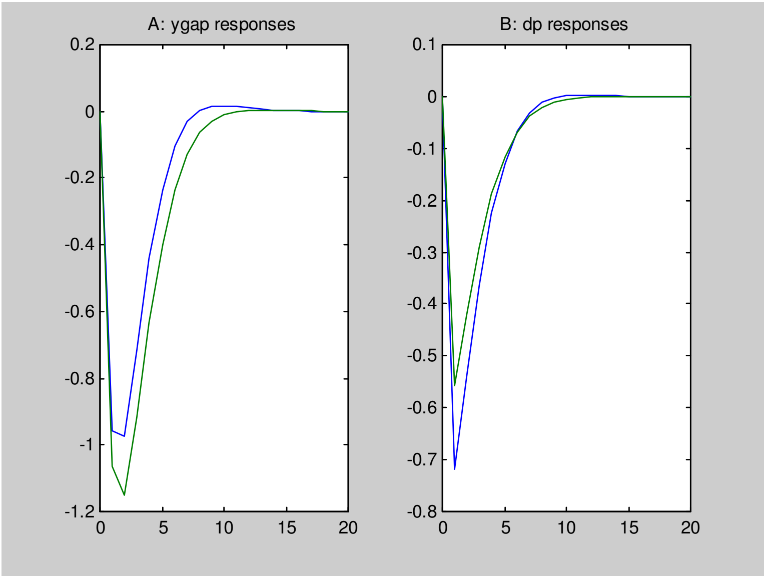

Figure 3: Responses to a 1 percentage point rise in the nominal interest rate - high λ_l (dotted lines) *vs* low λ_l (solid lines).

equilibrium unemployment rate from 9.8% to 8.6%. As expected from the results in Aguiar and Ribeiro (2008), such reform improves welfare stabilization as long as habit persistence is not too strong. In particular, permanent stabilization gains are higher for $h = 0.2$ and they are steadily reduced with the degree of habit persistence. Moreover, the impacts of a reform in b on monetary policy effectiveness are, quantitatively, quite robust across the different monetary policy rules.

To make possible the comparison with the impacts derived from the change in the unemployment-benefit replacement ratio, we have calibrated the changes in the other labor market reform devices so as to yield the same reduction in the steady-state unemployment rate (see the Appendix).

Figures 4 to 6 show that a reduction in c is preferable to a reduction in Γ and both are preferable to a reduction in b; this applies both for the simple TR as well as for the inflation targeting rule. Under the TR with smoothing (Figure 5), and for a significant interval of habit persistence degrees, the reform rank diverges: from $h = 0.2$ to h near 0.65, the reduction in the unemployment benefit is the most preferable institutional change while a reduction in c delivers, among these, the lowest stabilization gains. Reforms are relatively more attractive under inflation targeting: higher stabilization gains occur, even for high levels of habit persistence (until h is close to 0.7). For intermediate values of h (0.4 to 0.6), reform effects are quite identical under the TR and under the inflation targeting regime.

A reduction in the exit rate (λ_l) is always destabilizing, except when the TR with smoothing applies - under which welfare stabilization gains occur throughout a large span of habit persistence (from $h = 0.3$ to $h = 0.8$).

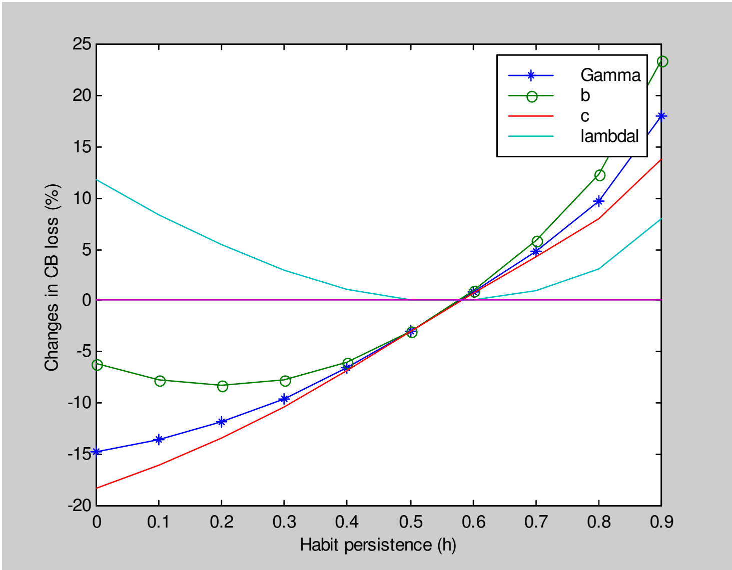

Figure 4: Permanent effects on the central bank's Loss under the Taylor rule.

In short, the incentive for a conservative central bank to argue in favor of more flexible labor markets depends on the degree of habit persistence, but also on the specific policy rule, for a given combination and calibration of shocks hitting the economy.

In order to make a deeper analysis of these results, Figures 7 and 8 show the impacts of the alternative stylized reforms on monetary policy effectiveness for different combinations of habit formation with technology shock persistence (ρ_a) and with the relative weight of the demand and technology shocks hitting the economy, respectively. For the sake of illustration, the reported results apply to the TR with smoothing, but the following analysis is broader.

We conclude that, for higher degrees of habit persistence, labor market reforms deliver higher permanent stabilization costs the larger the autocorrelation attached to technology shocks is (Figure 7). Only the impacts of changes in λ_l are relatively less sensitive to changes in ρ_a. In general, the positive effects of reforms on CB Loss occur for a large range of habit persistence degrees if inflation targeting is in place: results not reported show that, under this rule, reform permanent effects are relatively more sheltered from technology shock persistence.

Furthermore, reforms hardly enhance the CB stabilization role if high habit persistence is coupled with a high weight put on demand and technology shocks (Figure 8). We conclude, as before, that changes in λ_l are hard to support, except if cost-push shocks strongly dominate.

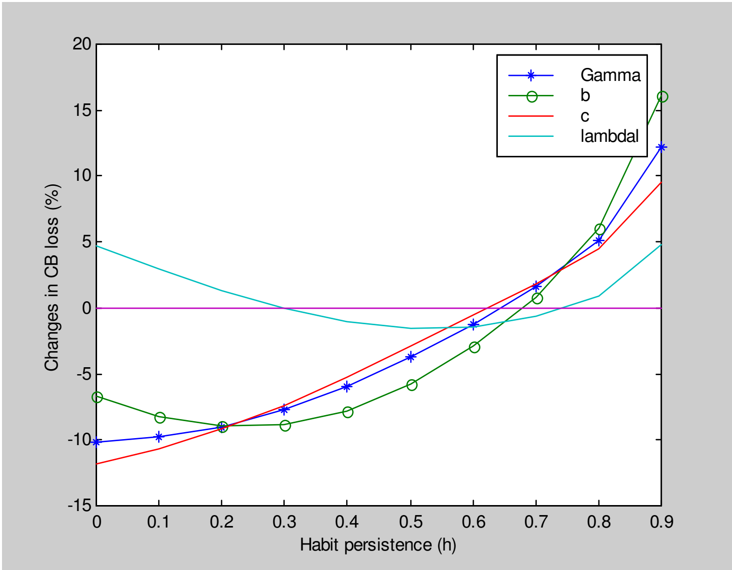

Figure 5: Permanent effects on the central bank's Loss under the Taylor rule with smoothing.

4 Final Remarks

Although central banks often advocate labor market reforms, the presence of habit persistence in consumption can prevent the emergence of policy stabilization gains. This is crucial if the central bank, meaning the social planner, attaches too much weight to inflation stabilization.

Aguiar and Ribeiro (2008) concluded that, under high habit persistence in consumption, a reduction in unemployment-benefit replacement ratio can lead to permanent stabilization losses for an inflation-averse central bank. Improving on their model by including an explicit search and matching framework, we have studied how habit persistence and non-optimal monetary policy rules interact in order to assess under what conditions a labor market reform can improve the effectiveness of monetary policy.

As expected, our results show that the labor market functioning crucially shapes the monetary transmission mechanism. In general, when the central bank shocks the nominal interest rate, inflation variability increases relative to output's and the effects on macro variables become less persistent under a more flexible labor market. This proves that labor market flexibility may make stabilization costs worse in face of demand and technology shocks; moreover, these costs increase with the persistence of shocks and with the preferences of the central bank for more inflation stabilization relative to output's.

We have also concluded that labor market reforms deliver positive effects on the central bank's Loss, as long as the degree of habit persistence is not too strong ($h < 0.7$). However, and depending on their nature, reforms impinge differently on monetary policy effectiveness: under the Taylor and the inflation targeting rules, the best outcomes are achieved, in decreasing order, with a reduction in vacancy costs, in the workers'

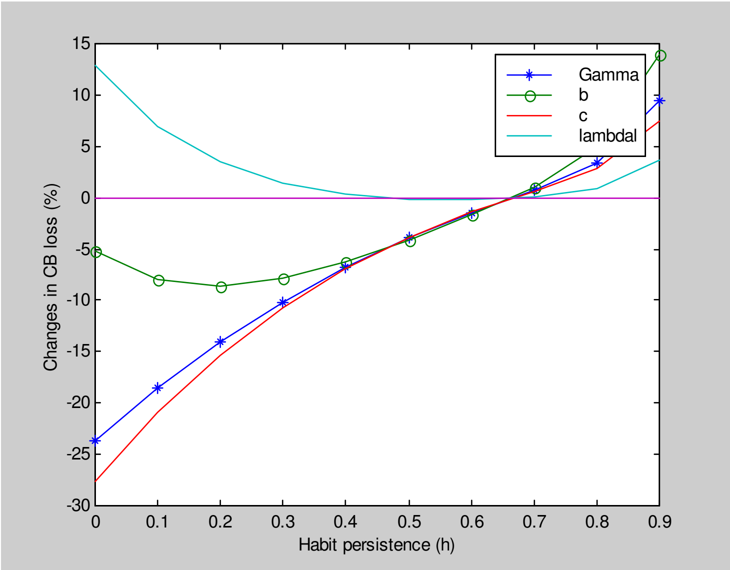

Figure 6: Permanent effects on the central bank's Loss under the inflation targeting rule.

bargaining power and in the unemployment-benefit; the rank is reversed under the Taylor rule with smoothing. Reforms aimed at reducing the exit rate improve welfare for a considerable range of h but only under smoothing.

The inflation targeting rule accommodates positive permanent effects of the reforms for the widest range of habit persistence degrees; conversely, reform gains are less robust across different degrees of habit formation under the Taylor rule.

Even for high degrees of habit persistence, reform may still improve permanent stabilization costs if demand and technology shocks are less important than cost-push ones in hitting the economy. Again, changes in the exit rate are the hardest to support, except if cost-push shocks strongly dominate.

In short, the incentive for a conservative central bank to argue in favor of more flexible labor markets depends crucially on the degree of habit persistence, on the specific policy rules and on the combination and persistence of the different shocks hitting the economy.

5 Appendix: Model Calibration

Table 1 presents the model calibration. When appropriate, parameter values were kept, following the respective supporting arguments, at the levels chosen in Aguiar and Ribeiro (2008).

For the labor market baseline parameters, we start by updating the steady-state equilibrium unemployment rate. Following Moyen and Sahuc (2005), we take the NAIRU for the Euro area by setting the after-reform steady-state unemployment rate to 8.6%; moreover, this value is quite close to the Euro area average from 1998 to 2007 (Eurostat data). Given the equilibrium unemployment rate, we take ϱ_m=1 and the unemployment-

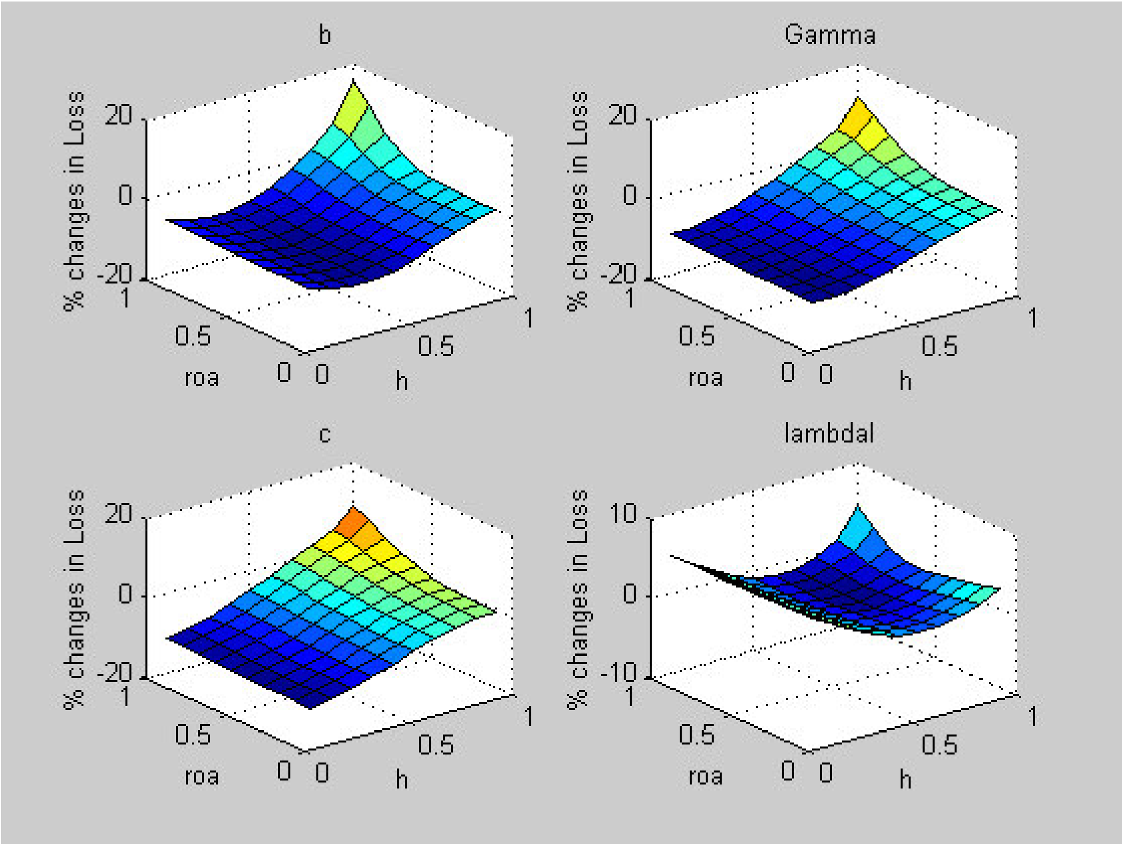

Figure 7: Permanent effects on central bank's Loss under the Taylor rule with smoothing - across different values for ρ_a and for h.

to-vacancy elasticity of the matching function (ϱ) equal to 0.5 (midpoint of the values typically used in the literature, according to a survey in Gertler and Trigari, 2006). The job destruction rate (λ_l) was set in order to yield a job finding probability of 0.5, compatible with an average unemployment spell of 6 months (European average according to Christoffel *et al.*, 2006 and Moyen and Sahuc, 2005)[5] - recall equation (19). The resulting λ_l is 0.047, a value that is in line with the one used in Moyen and Sahuc (2005) for the Euro area.[6] Additionally, the corresponding steady-state vacancy rate ($\bar{v}$) of 0.0215 yields an average vacancy duration of 1.5 months. This latter value is in accordance with the average (from 2001 to 2005) vacancy rate that we have computed using the available data for some selected Euro area countries (Eurostat data).

The vacancy cost parameter (c) was set so as to render the steady-state outcome of the labor market equilibrium under flexible prices (derived from equation 18 together

[5] Our computations, using data released by the Eurostat Queentree, imply an average duration of unemployment in the interval 6 to 11 months for the euro area; without data on the dispersion within the interval, the unemployment spell may be slightly above 6 months.

[6] This value is roughly half of that used by Christoffel *et al.* (2006), because the latter assume a (too high) steady-state unemployment rate of 15%.

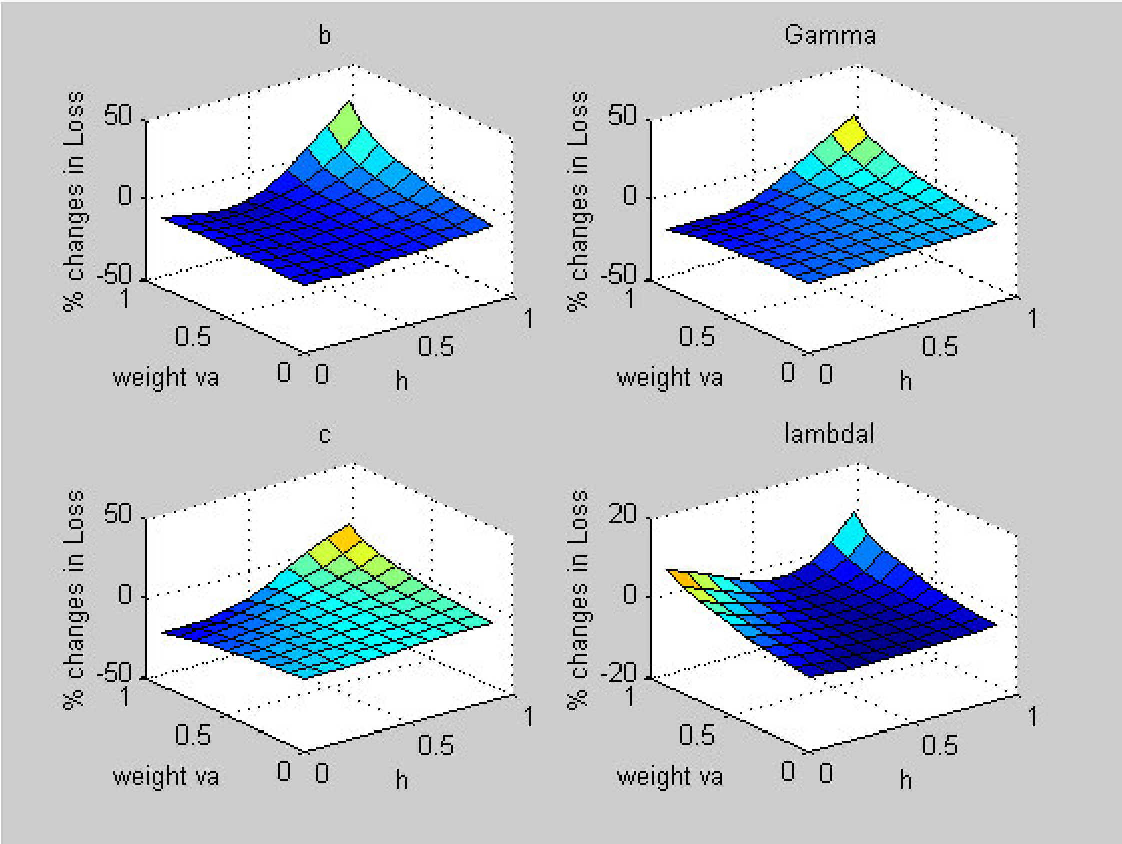

Figure 8: Permanent effects on central bank's Loss under the Taylor rule with smoothing - across different relative weights on demand and technology shocks (υa) and different h

with equation 17) compatible with the steady-state unemployment rate underlying the employment dynamics (equation 19).

Finally, we kept the indicative European after-reform unemployment-benefit replacement ratio of 60% based on Layard *et al.* (1991), in order to ensure comparability of the effects of a reform in b with the results in Aguiar an Ribeiro (2008). This replacement ratio is slightly above the average value observed for some European countries from 1980 to 1999 and reported in Nickell *et al.* (2005). The value for Γ is kept low, at 0.1. The alternative values for the labor market institutional parameters presented in Table 1 refer to the pre-reform levels; all of which were set so as to yield a pre-reform equilibrium unemployment rate of 9.8%.

In respect to monetary policy, we consider an inflation-averse central bank by setting ω_y=0.01 (following McCallum and Nelson, 2004). For the non-optimal interest rate rule we chose Taylor's original feedback parameters and took the interest rate smoothing parameter from McCallum and Nelson (2004). Additionally, we consider a strict inflation targeting Taylor rule, calibrated according to Faia (2006): $\phi_\pi = 3, \phi_y = \rho_r = 0$.

The values for the parameters characterizing the processes of the shocks were also

Description	Parameter	Value
Price elasticity of demand	ε	11
Quarterly discount factor	β	0.99
Probability of firms not changing prices in a given period	θ	0.83
Labor intensity	α	0.9
Technology index	A	1
Efficiency in the matching process	ς_m	1
Unemployment-to-vacancy elasticity in matching function	ς	0.5
Low / High unemployment-benefit replacement ratio	b	0.6 / 0.7
Low / High workers' bargaining power	Γ	0.077 / 0.1
Low / High job destruction rate	λ_l	0.042 / 0.047
Low / High vacancy-cost parameter	c	6.108 / 7.825
Relative weight on output stabilization in the Loss function	ω_y	0.01
Taylor rule / inflation targeting feedback parameter on inflation	ϕ_π	0.5 / 3
Taylor rule feedback parameter on the output-gap	ϕ_y	0.125
Taylor rule interest rate smoothing parameter	ρ_r	0.8
Demand-side shock properties: standard-deviation	σ_υ	0.02
Cost-push shock properties: standard-deviation	σ_u	0.005
Technology shock properties: standard-deviation, autocorrelation	σ_a, ρ_a	0.007, 0.95

Table 1: Parameter calibration.

taken from McCallum and Nelson (2004), and they refer to a model close to our calibration.

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